Chapter 7

Drafting Technology Standards

Standards in Drafting Technology address the technical world's primary means of communication, visual communication, which, in various forms, affects people in nearly every walk of life. The Drafting Technology standards provide a model for the development of drafting technology program curricula for high school programs through lifelong instructional delivery systems, including retraining programs and programs for upgrading of skills. Curriculum designed from these model standards prepares persons for employment or advanced training in a variety of industries. Programs operating on standards-based curricula provide the workforce with individuals who can plan, prepare, and interpret mechanical, architectural, structural, marine, piping, electrical, electronic, topographical, and other drawings.

Drafting Technology programs in California provide students with the skills to enter the workforce in an entry-level position directly out of high school and ROC/P, at the technical level after community college, or at the professional level after receiving a bachelor's degree. This sequence begins after the Technology Core program, with a broad-based course, Introduction to Drafting. The career path sequence is then tailored to each student's goal by providing the student the opportunity to enroll in such programs as Mechanical Drafting, Architectural Drafting, Technical Illustration, Electronic Drafting, and Civil Drafting.

Drafting Technology education programs form a powerful and positive, integrated linkage with all other disciplines. Knowledge and skills across disciplines are enhanced and reinforced, enabling students to compete in the U.S. economy as productive citizens. These programs are provided in the context of a complete sequential program in which students are able to plan intelligently and prepare properly for a career goal.

In the drafting program students use mathematical skills, such as estimating and problem solving, in the application of algebraic, geometric, and trigonometric formulas and functions. Students practice communications by applying reading, writing, listening, speaking, visual, and nonverbal skills. Students also learn and practice scientific principles that apply to mechanical, fluid, thermal, electronic, and electrical systems. These scientific principles include the principles of force, work, rate, resistance, energy, power, and momentum.

Drafting Technology students also use construction, electronic, and manufacturing principles. Sample skills include construction design; infrastructure design; tool design; technical illustrations; electronic circuit board design; welding; and machine operations and processes. These interdisciplinary approaches provide students with strong foundation skills and with advanced-level skills in the career field of their choice, skills which allow students to exit programs at selected points and enter into identified occupations or advanced training.

The Drafting Technology standards cover the development of drafting skills and concepts and integrated skills, from the general or exploratory to the occupational specific, providing a path in which students can develop to their greatest potential and prepare to achieve postsecondary goals. All students have the right to select a career path directly related to their particular career and personal goals and receive education and training to make their goals possible. Students are able to take the necessary prerequisite courses for

their chosen paths by developing their own individualized plan. Bridges exist to help students move from one path to another as they mature and develop through their high school years.

The course Computer-Aided Drafting/Design and Operation and its relationship to the technical fields of construction, engineering, graphic communications, manufacturing, electronics, and transportation and energy must be a part of the student's career path in Drafting Technology.

Career–technical performance standards and model curriculum integrated performance activities for Drafting Technology are presented in this chapter. The reader should review career–technical standards concurrently with related career performance standards and academic performance standards, described fully in Chapter 2, "Industrial and Technology Education Model Curriculum Standards."

Career–Technical Performance Standards

Standard 1: History of Drafting

Students will understand, classify, and be familiar with historical events, from cave writings to computer-aided drafting systems, as a development of graphic language.

Standard 2: Drafting Careers/Career Paths

Students will know the types of careers related to and utilizing drafting skills and knowledge. Students will develop charts and diagrams identifying a variety of drafting-related careers and the preparation required for those careers.

Standard 3: Care and Use of Tools and Equipment

Students will understand various tools, equipment, media, and materials used in all fields of drafting and will understand methods and techniques for employing them appropriately. Students will correctly refer to, use, and care for drafting tools, equipment, media, and materials.

Standard 4: Drafting Measurement

Students will understand measuring systems and how measuring instruments are used in drafting and related fields. Students will measure to the degree of accuracy required in a variety of particular drafting applications.

Standard 5: Lettering

Students will know the importance of quality lettering and the variety of lettering fonts used in the various disciplines. Students will apply appropriate lettering techniques and fonts when creating drawings.

Standard 6: Sketching

Students will understand the reason for applying various types of orthographic and pictorial drawings, such as axonometric, oblique, and perspective drawings. They will produce well-proportioned and easily understood two- and three-dimensional sketches.

Standard 7: Orthographic Drawing

Students will understand, identify, and correctly use the alphabet of lines. They will develop an object graphically, using appropriate projection techniques.

Standard 8: Dimensioning Practices

Students will understand and apply dimensioning practices to drawings, using the current standards of dimensioning and tolerancing for a variety of drafting applications.

Standard 9: Sectioning

Students will understand section view applications and functions. They will incorporate section views and appropriate cutting planes to clarify hidden features or objects on drawings.

Standard 10: Pictorial Drawing

Students will understand the structure, components, types, sequential construction methods, and applications of pictorial assemblies. They will draw objects accurately in pictorial format.

Standard 11: Tolerancing Relationships

Students will understand tolerance relationships between functional mating parts and will calculate and apply correct tolerancing conventions to drawings.

Standard 12: Reprographics

Students will know the accepted methods and materials used in reprographics. They will select and use the appropriate materials and methods to reproduce original drawings.

Standard 13: Assembly Drawings

Students will understand, organize, and complete an assembly drawing, using information collected from detail drawings.

Standard 14: Computer-Aided Drafting/Design (CADD) and Operations

Students will understand how to use hardware and design software to create geometry and will apply dimensioning practices to complete drawings. Students will organize drawings, using accepted CADD procedures. Students will apply appropriate software file-management procedures. They will produce hard copies of the completed drawings and provide electronic files for a variety of graphic outputs.

Standard 15: Research and Design

Students will understand research and design strategies that are environmentally safe and appropriate to manufacturing and construction product development in selected technologies. They will incorporate these strategies (e.g., ideation, review of literature, rough sketches, study model, final sketches, prototype development, prototype evaluation) in the universal problem-solving approach (e.g., input, process, outcome, feedback) for the development of manufacturing and construction products.

Standard 16: Three-Dimensional Geometry

Students will understand the difference between wire-frame and surface and solids modeling. They will develop geometry of three-dimensional objects and manipulate the drawings, applying hidden-line removal, shading, and animation.

Standard 17: Applied Geometry

Students will understand how to visualize and calculate mathematically a variety of geometric forms. They will construct, structure, form, design, and geometrically define objects and surfaces.

Standard 18: Auxiliary Views

Students will understand how auxiliary views are projected and used to clarify a drawing. They will utilize primary and, when applicable, secondary auxiliary planes and revolutions.

Standard 19: Geometric Tolerancing

Students will understand current industrial standards of geometric symbology. They will apply the symbology to the function of the parts and the design intent.

Standard 20: Development Drafting

Students will understand, develop, and draw flat layouts of a variety of objects.

Standard 21: Working and Production Drawings

Students will understand the relationship of detail drawings, assembled drawings, and working drawings. Students will complete the various types of working drawings, using appropriate line work, symbology, and current standards.

Standard 22: Piping Drafting

Students will know the symbols for different types of pipe fittings and valves. They will complete piping drawings to current industry standards, using appropriate symbols.

Standard 23: History of Architecture and Architectural Drafting

Students will understand and explain the technological changes that have occurred throughout the history of architectural drafting.

Standard 24: Architectural Drawing Procedures

Students will understand, select, and use professional architectural drawing procedures that are consistent with current industrial standards.

Standard 25: Architectural Working Drawings

Students will understand and develop architectural working drawings, using current industry standards.

Standard 26: Structural Drafting

Students will understand the use of the four basic structural materials: wood, steel, masonry, and concrete. They will complete structural drawings to current industrial standards.

Standard 27: Electronic Drafting

Students will understand, classify, and use various electronic components, symbols, abbreviations, media, and standards of electronic drawings.

Standard 28: Electronic Diagrams

Students will understand and draw appropriate block, schematic, wire and cable, and logic diagrams, using current industry standards.

Standard 29: Technical Illustration

Students will understand and apply illustration techniques in pictorial format consistent with current industry standards.

Standard 30: Civil Drafting

Students will understand geographic, topographic, and cadastral mapping techniques and apply them to drawings, using current industry standards.

Model Curriculum Integrated Performance Activities

Standards in all the industrial and technology education curriculum clusters are written as broad-based performance standards. Integrated performance activities describe classroom or workplace student activities that reflect two or more performance standards. They are specifically intended to provide instructors and curriculum developers with examples of activities designed to promote the student's acquisition of selected standards. Classroom teachers will have the option of using the integrated performance activities as developed here or of modifying them to fit local needs, objectives, or individual teaching styles.

A limited selection of integrated performance activities is provided in this document to facilitate an understanding of performance standards. Subsequent and companion handbooks or curriculum development guides will provide a complete reference to integrated performance activities for all industrial and technology education curriculum clusters. Integrated performance activities are subject to constant change, including additions, item corrections and rewrites, deletions, and the like. Integrated performance activities are subject to constant modification to keep pace with the changing needs of students, business and industry, and the educational milieu.

Selected activities are as follows (draft copies of an activities handbook are available on request from consultants listed on pages xiii and xiv):

Activity 2: Graphic Language

Students catalog historical information on drafting as a graphic language. Students formulate correct safety procedures used daily in the classroom drafting environment.

Drafting Standards	1, 2, 3
Career Performance Standards	2, 3, 5
Academic Performance Standards	22, 30

Activity 20: Tolerancing Relationships

Using tolerancing criteria of a problem and following necessary conventions, students or small groups interpret and calculate dimensioning information and apply the information to a drawing. Suggested problems include (1) rough opening of window or door; (2) PC board traces; (3) hole and shaft fit; (4) bend radius; (5) gear and cog meshing; and (6) cam function.

Drafting Standards	3, 4, 5, 7, 8, 9, 11, 13, 14
Career Performance Standards	1, 2, 3, 4, 7
Academic Performance Standards	2, 10, 11, 20, 21, 22, 40

Activity 25: Assembly Drawing

An assembled project that has multiple parts will be selected. Students draw these parts as detail drawings. Then they make the necessary calculations for the tolerances and fits of their assembly drawing. From this information students draw the assembly drawing and present it to the class.

Drafting Standards	3, 4, 7, 10, 11, 13, 15
Career Performance Standards	1, 2, 3, 4, 7
Academic Performance Standards	2, 10, 11, 12, 13, 20, 21, 23, 40

Activity 27: Computer-Aided Drafting/Design (CADD) and Operations

Students complete drafting design problems in several drafting disciplines, using correct drafting conventions, and apply appropriate dimensioning standards. ANSI Y14.5, architectural, electrical, and metric standards are applied to the respective drawings. Students organize drawings according to accepted CADD procedures, using prototypes of A-E paper sizes which include layers, colors, and all applicable parameters. Students keep records of all files on log sheets, organize them into categories, and keep backups of all files. Completed solutions are output on a variety of hard-copy devices and are prepared for use in shading and animation software. Students prepare a variety of file formats and understand how the formats are used to transfer files.

Drafting Standards	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15
Career Performance Standards	1, 2, 3, 4, 5, 6, 7
Academic Performance Standards	1, 2, 10, 11, 12, 13, 20, 22, 30, 40

Activity 31: Detail Drawings

Given pictorial views of several objects, the student develops the necessary views to describe the object fully. The student applies the techniques used in auxiliary projections, geometric construction, development drafting, orthographic projection, descriptive geometry, and dimensioning. Problems are to be solved in one or more of the following fields: mechanical, electrical, architectural, piping, civil, and development drafting.

Drafting Standards	3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 16, 17, 18, 19, 21, 25, 26, 27, 30
Career Performance Standards	1, 3, 5, 7
Academic Performance Standards	10, 11, 12, 13, 20, 40

Activity 38: Production Drawings

Students or small groups will be given the specific criteria of a functional part and will demonstrate the ability to use the correct tools and equipment, methods, and techniques to produce a set of production drawings conforming to industrial standards.

Drafting Standards	1, 3, 4, 5, 7, 8, 9, 11, 12, 13, 14, 16, 17, 18 19, 20, 21, 22, 25, 26, 27, 28, 29, 30
Career Performance Standards	1, 2, 3, 4, 5, 6, 7
Academic Performance Standards	1, 2, 3, 10, 11, 12, 13, 20 ,40

Activity 53: Technical Illustration

Given the functional criteria of a problem and the necessary conventions, students or small groups interpret and calculate the information; then apply the results to the appropriate type of pictorial representations, illustrations, or patent drawings, using the specific materials and media as required. Suggested problems include (1) exploded assembly drawing containing a minimum number of associated parts; (2) exterior residential or commercial building rendering with landscaping and other requirements, in an appropriate medium with a presentation mat; (3) interior residential or commercial building rendering with furnishings and accessories, in an appropriate medium with a presentation mat; and (4) patent drawings.

Drafting Standards	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 25, 26, 27, 28, 29, 30
Career Performance Standards	1, 2, 3, 4, 7
Academic Performance Standards	2, 3, 10, 11, 12, 13, 20, 21, 40

Activity 57: Topographic Mapping

In individual or group projects, students use predetermined data (or data which the students have found) to draw topographic lines representing the elevations of a particular area. Using data from engineering firms or other sources, students draw topographic maps to scale and develop plan and profile drawings from existing drawings or drawings done by the students. Staff from an engineering firm demonstrate the use of surveying equipment. Using a level, the students determine the elevations of various areas around the school and draw a topographic map of the area to scale. Students research land ownership and methods of measurement and compare the methods with current technology. Students with equipment or simulated information gain practice in drawing topographic maps to scale.

Drafting Standards	2, 3, 4, 5, 7, 8, 14, 15, 17, 30
Career Performance Standards	1, 2, 3, 4, 6, 7
Academic Performance Standards	1, 4, 10, 11, 13, 20, 21

Activity 58: Cadastral Mapping

Students working in a group or individually use bearings of line to develop a cadastral map of a given subdivision or civil boundary. Using simple, compound, and reverse curves, students develop a plat and calculate the curve data for the various curves. Students design and plan a subdivision with minimum-sized lots for a given a parcel of land, considering local regulations for subdivision design. The students also plan for the utilities that must accompany the subdivision design. Students calculate curve data, area, tangents, chords, deflection angles, and delta curves for various lots within a subdivision.

Drafting Standards	2, 3, 4, 5, 7, 8, 14, 15, 17, 30
Career Performance Standards	2, 3, 4, 7
Academic Performance Standards	1, 4, 10, 11, 12, 13, 20, 21

Page 92 is
blank.

Chapter 8

Electronic Technology Standards

Electronic Technology Career Cluster Programs prepare individuals for employment or advanced training in a variety of electronic industries. These programs prepare persons to work as technicians and engineers and other professionals who perform research and design, manufacturing, maintenance, and service functions. Instruction in these programs includes theory; underlying physical science and mathematics; equipment, including electronic and mechanical devices and test equipment; and analog and digital circuitry. The range of instruction includes assembly, installation, operation, maintenance, and repair of mechanical, fluid, electrical, and thermal systems used in the electronics industry. Further training in these programs prepares persons for the application, design, development, and testing of equipment and electronic interfaces. Individuals will be prepared to communicate effectively with coworkers, supervisors, and clients and to solve technical problems, write reports, and make oral presentations.

Electronic Technology programs in California provide students with the skills needed to enter the workforce in an entry-level position directly out of high school and ROC/P, at the technical level after community college, or at the professional level after receiving a bachelor's degree. This sequence begins after the Technology Core program, with a broad-based course in Introduction to Electronics. The career path sequence is then tailored to each student's goal by providing to the student the opportunity to enroll in a variety of Electronic Technology programs.

Students who exit the program with a high school diploma, certificate of competency, or license after completing high school or an ROC/P, or both, will be qualified for jobs ranging from entry-level to skilled positions in the electronics industry. Examples of those positions include electronics assembler, electronics mechanic, electronics tester, and telephone repairer and installer.

Students who exit the program with an associate degree, certificate, certification, or license after completing two or more years of postsecondary education will be qualified for a technical or supervisory-level position in the electronics industry. Examples of those positions include electronics technician, laser technician, avionics technician, or computer service technician.

Students who exit the program with a bachelor's degree, certificate, or license after completing four or more years of a postsecondary program will be qualified for a professional or management position in the electronics industry. Examples of those positions include electronics engineer, computer engineer, or telecommunication engineer.

Electronics model curriculum standards focus on students' acquisition of new knowledge, awareness of individual interests and abilities, and the application and transfer of skills learned in other disciplines.

Electronic Technology education programs form a powerful and positive integrated linkage with all other disciplines. Knowledge and skills across disciplines are enhanced and reinforced, enabling students to compete in the U.S. economy as productive citizens. These programs are provided in the context of a complete sequential program in which students are able to plan intelligently and prepare properly for a career goal.

In the electronics program students use mathematic skills, such as estimating and problem solving, in the application of algebraic, geometric, and trigonometric formulas and functions. Students practice communications by applying reading, writing, listening, speaking, visual, and nonverbal skills. Students also learn and practice scientific principles that apply to mechanical, fluid, thermal, electronic, and electrical systems. These scientific principles include the principles of force, work, rate, resistance, energy, power, and momentum.

Electronic Technology students also utilize construction, graphic communications, transportation, energy, and manufacturing principles. Sample skills include construction design; infrastructure design; tool design; graphic illustrations; mechanical, hydraulic, and pneumatic operations; welding; manufacturing, energy, and transportation systems; and machine operations and processes. These interdisciplinary approaches provide students with strong foundation skills and with advanced-level skills in the career field of their choice, skills which allow students to exit programs at selected points to enter identified occupations or advanced training.

The Electronic Technology standards cover the development of electronic skills and integrated skills, from the general or exploratory to the occupational specific, providing a path in which students can develop to their greatest potential and prepare to achieve postsecondary goals. All students have the right to select a career path directly related to their particular career and personal goals and receive education and training to make their goals possible. Students are able to take the necessary prerequisite courses for their chosen paths by developing their own individualized plan. Bridges exist to help students move from one path to another as they mature and develop through their high school years.

Career–technical performance standards and model curriculum integrated performance activities for Electronic Technology are presented in this chapter. The reader should review career–technical standards concurrently with related career performance standards and academic performance standards, described fully in Chapter 2, “Industrial and Technology Education Model Curriculum Standards.”

Career–Technical Performance Standards

Introductory

Standard 1: Fabrication and Assembly

Students will understand the fabrication processes and how they are applied in the electronics industry. Using the specialized and common tools of the electronics trade, students will fabricate complete circuits that meet established industry standards.

Standard 2: History of Electricity/Electronics

Students will understand the historical developments in electricity and electronics that have led to the current technology. They will explain the impact of those historical developments and discoveries on current technology.

Standard 3: Identifying Electronic Components

Students will understand resistor color codes and component labeling. They will identify components and interpret data sheets.

Standard 4: Direct-Current (DC) Circuits

Students will analyze relationships between voltage, current, resistance, and power related to direct-current circuits. They will calculate, construct, measure, and interpret DC circuits.

Standard 5: Units of Measure

Students will understand how electricity and electronics are composed of interactive, measurable forces: voltage, amperage, resistance, and power. Students will analyze and predict effects of circuit conditions, based on measurements and calculations of voltage, current, resistance, and power.

Standard 6: Alternating-Current (AC) Circuits

Students will understand the characteristics of alternating current and how it is generated; the sine wave; basic characteristics of AC circuits, tuned circuits, and resonant circuits; and the nature of the frequency spectrum. Students will calculate and apply the principles of alternating current to design various AC circuits.

Advanced

Standard 7: Sources of Electromotive Force

Students will be familiar with various forms of energy, such as electrical motion, chemical, thermal, piezoelectric, solar, and so forth, and will understand how conversion processes can transform one form of energy into another. Students will apply conversion technology to generate electricity.

Standard 8: Analog Circuits

Students will understand analog circuits. Students will identify, describe, and trace signal paths in the operation of basic electronic stages relating to AM, FM, television, and other similar devices.

Standard 9: Integrated Circuits

Students will understand fabrication techniques, input and output signals, biasing voltages, integrated circuit terminology, symbols, applications, and testing procedures. Students will select circuit types, predict outcomes, and explain why one type of circuit is used in lieu of another, using truth tables and Boolean algebra concepts.

Standard 10: Solid-State Devices

Students will understand basic semiconductor physics and characteristics; applications of diodes, positive-negative junction, uni-junction, and field effect transistors; and basic transistor-circuit configurations and their practical applications. Students will select and design a circuit, using the mathematical and scientific concepts of solid-state devices and circuits.

Standard 11: Electrical Wiring

Students will understand principles of electrical codes, wiring applications, and circuit/device troubleshooting. They will fabricate electrical circuits that meet or exceed applicable codes and industry standards.

Standard 12: Electric Motors

Students will understand proper connection of motors to power sources for varied applications. Students will troubleshoot and repair inoperative motor circuits and equipment.

Standard 13: Low-Voltage Control Circuits

Students will understand the operation and application of low-voltage control signal circuits, such as heating/air-conditioning thermostat/relay-control circuits. They will recommend and install low-voltage control signal circuits.

Standard 14: Communications System

Students will know the principles of electronic communication systems. Students will determine the compliance of communication equipment with technical and regulatory operation requirements.

Standard 15: Instrumentation

Students will understand how various electrical and electronic testing devices are used. Students will choose and apply appropriate electronic instruments to analyze, repair, or measure electrical/electronic systems, circuits, or components.

Standard 16: Broadcast Systems

Students understand how to confirm operating parameters, apply test procedures, make necessary adjustments, and assemble the components of a broadcast system. Students will analyze broadcast-system operations and perform necessary repairs.

Standard 17: Digital Circuits

Students will understand number systems, logic functions, memory circuits, and clock and timing circuits and their applications to electronic systems. Using logic functions, students will design digital circuits, build digital circuits, and troubleshoot digital systems to the individual-chip level.

Standard 18: Optical Electronics

Students will understand basic optoelectronic circuitry, the nature of light, light sources, and light amplification and the integration of optical systems into electronic systems. They will analyze, troubleshoot, and repair optical and optoelectronic systems.

Standard 19: Microprocessors

Students will understand microprocessor fundamentals, terminology, architecture, bit capacity, and bus systems and the interactive roles of software and hardware. They will analyze and troubleshoot computer-processing units (CPUs), bus systems, memory systems, and input/output ports.

Standard 20: Avionics

Students will understand the construction and function of major types of avionics systems currently in use. They will analyze and troubleshoot avionics systems and determine faulty units in a system for removal and repair.

Standard 21: Consumer Product Servicing

Students will understand basic home audio and video entertainment receiving, recording, and distribution systems; proper troubleshooting techniques; and operational checks. Students will perform operational checks, troubleshoot, and perform minor adjustments.

Standard 22: Industrial Systems

Students will understand and explain the principles of operation and applications of transducers, sensors, and electronic or electromechanical controllers used in industrial manufacturing.

Standard 23: Hybrid Microelectronics

Students will understand processes associated with hybrid microelectronic technology, including graphic circuit design; photo-tooling; substrate fabrication; component assembly; packaging; process control and inspection; quality assurance and reliability testing; and incoming materials control. Students will conduct reviews of circuit design and perform and interpret tests related to each of those processes.

Standard 24: Biomedical Electronics

Students will understand the importance of electronic instrumentation in the medical field. Students will conduct simple experiments to determine uses of biomedical equipment for monitoring and controlling body functions.

Standard 25: Software Fundamentals

Students will understand the fundamentals of DOS, programming for technicians, and software diagnostics. Students will write, store, edit, and retrieve programs to troubleshoot systems or solve electronic mathematical problems.

Standard 26: Peripheral Communication Interfacing

Students will understand the major EIA and IEEE standards currently in use for SYNC and ASYNC devices; networking levels or layers; protocols; and packet switching. They will identify, define, analyze, and troubleshoot communication interfacing problems in systems and determine faulty units in a system for removal and repair.

Standard 27: Electrostatic Discharge

Students will understand the basic theory and concepts of electrostatics; the key elements of electrostatic discharge (ESD); the purpose of protective packaging and labeling; the sources of possible electrostatic hazards in the electronic work area; and the four parts of an ESD control program. They will demonstrate the daily ESD self-check procedure that all electronic technicians must follow.

Standard 28: Quality Assurance

Students will understand the philosophy, processes, and elements of a quality assurance (QA) system. They will apply the fundamental elements of QA to a performance task. They will analyze and define the relationship between the elements of QA and repetitive performance to achieve a QA goal. Students will conduct QA goal reviews to determine objective requirements, reliability, and safety criteria in order to troubleshoot and solve a QA problem.

Model Curriculum Integrated Performance Activities

Standards in all the industrial and technology education curriculum clusters are written as broad-based performance standards. Integrated performance activities describe classroom or workplace student activities that reflect two or more performance standards. They are specifically intended to provide instructors and curriculum developers with examples of activities designed to promote the student's acquisition of selected standards. Classroom teachers will have the option of using the integrated performance activities as developed here or of modifying them to fit local needs, objectives, or individual teaching styles.

A limited selection of integrated performance activities is provided in this document to facilitate an understanding of performance standards. Subsequent and companion handbooks or curriculum development guides will provide a complete reference to integrated performance activities for all industrial and technology education curriculum clusters. Integrated performance activities are subject to constant change, including additions, item corrections and rewrites, deletions, and the like. Integrated performance activities are subject to constant modification to keep pace with the changing needs of students, business and industry, and the educational milieu.

Selected activities are as follows (draft copies of an activities handbook are available on request from consultants listed on pages xiii and xiv):

Activity 2: Prototype Construction and Assembly

Given a schematic diagram and components, students determine proper component placement and construct, assemble, and solder those components, using point-to-point, printed circuit, or surface-mount technology. Using industrial guidelines, students determine the type of construction that is most effective for a circuit problem. Students collaborate during the process to facilitate the most effective method of construction. They may report their progress verbally or in writing during the exercise.

Electronics Standards	1, 3, 4, 5, 6, 7, 9, 11
Career Performance Standards	1, 2, 3, 4, 5, 6, 7
Academic Performance Standards	2, 3, 10, 20, 21, 22

Activity 12: DC Circuit Evaluation

Given components and various desired circuit outcomes, students determine the type of DC circuit configuration (e.g., series, parallel, or complex) to use to achieve a desired result. Students calculate values and construct and verify the resulting circuits. Data are recorded and used to predict possible results if circuit components are changed or fail during circuit operation.

Electronics Standards	1, 2, 3, 4, 5
Career Performance Standards	1, 2, 3, 4, 5, 6, 7
Academic Performance Standards	2, 10, 20, 21, 22

Activity 18: Impedance and Reactance Calculations

Given inductance values, capacitance values, resistance values, and reference material, students calculate reactance and impedance for RL, RC, and LC circuits. Students refer to appropriate manuals and texts for the necessary formulas. Students use scientific/engineering notation and algebra/trigonometry functions to determine values of impedance. Students compare and contrast

values from different circuit configurations. Students report the results orally or in writing to the instructor.

Electronics Standards	2, 3, 5, 6, 8, 10, 16
Career Performance Standards	1, 2, 3, 4, 6, 7
Academic Performance Standards	2, 10, 11, 12, 13, 20, 21, 22

Activity 28: Digital Circuits

Students construct digital circuits, then analyze and troubleshoot logic gates, flip-flops, registers, counters, timing circuits, multiplexers, de-multiplexers, memory devices, and displays. Students interpret data and describe conclusions in a written or oral presentation.

Electronics Standards	3, 4, 5, 11, 21
Career Performance Standards	1, 3, 4, 7
Academic Performance Standards	2, 10, 11, 12, 13, 20, 21, 22, 40

Activity 68: Digital Circuit Terminology

Given the following digital terminology and concepts, students explain (or identify the differences between) the method used to locate pin 1 on an IC; SSI, MSI, LSI, and VLSI; plastic versus ceramic packaging; through-hole versus surface-mount component installation; CMOS handling requirements; combination versus sequential logic circuits; synchronous versus synchronous counter circuits; decoders versus encoders; active-high versus active-low logic; position value or position weighing; bi-stable, monostable, and astable clock circuits; and the advantages and disadvantages of TTL, CMOS, ECL, and GaAs IC technology. Students work in study groups and report their answers to the class in a question and answer session.

Electronics Standards	3, 4, 11
Career Performance Standards	1, 3, 4, 7
Academic Performance Standards	2, 3, 10, 11, 12, 13, 20, 21, 22, 40

Activity 116: Antenna Design

Given a word problem that stipulates formulas and a drawing of a specific antenna design with an operational frequency, students calculate the physical dimensions of the components, using exponents in their work. The students build a model of the antenna to an exacting scale.

Electronics Standards	2, 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15,17,18, 20, 21
Career Performance Standards	1, 3, 4, 7
Academic Performance Standards	2, 10, 11, 12, 13, 20, 21, 22, 40

Page 100 is
blank.

Chapter 9

Engineering Technology Standards

The Standards In Engineering Technology address the international definition for Engineering Technology: "Engineering Technology is that part of the technological field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational spectrum between craftsman and the engineer at the end of the spectrum closest to the engineer" (Accreditation Board for Engineering and Technology [ABET]). The standards build on a foundation of science, mathematics, communication, and technology and include manufacturing, drafting, computer science, physical sciences, and chemical sciences. Students acquire an understanding of the properties of engineering materials; the design of mechanisms; the selection of machine components; power and energy technology; fluids and hydraulic applications; chemical interactions; and electrical/electronic circuitry.

Engineering Technology programs provide students with skills that will lead to an entry-level position after high school and ROC/P; a technical-level position after postsecondary preparation; or a professional career after a bachelor's degree is earned. Those positions span the technological spectrum, from that of the student who completes high school to that of the theory-oriented engineer. Applied practical or contextual teaching and learning, rather than theoretical and analytical methods, are emphasized. Engineering Technology students may choose career majors from fields in mechanical, civil, electrical, or chemical technology.

Students exiting the program with a high school diploma, certificate of competency, or license will be qualified for entry-level skilled jobs in the Engineering Technology career field.

Students exiting the program with an associate degree, certificate, certification, or license after completing two or more years of postsecondary education will be qualified for positions at the technical or supervisory level. Examples of such positions include those of aerospace engineering technician, computer-aided design technician, chemical engineering technician, civil engineering technician, computerized numerical control technician, environmental and hazardous materials technician, laboratory technician, and mechanical engineering technician.

Students exiting the program with a baccalaureate degree, certificate, or license after completing four or more years of a postsecondary program will be qualified for a professional or management position in Engineering Technology. Examples of such positions include those of aerospace engineer, chemical engineer, civil engineer, electrical engineer, and mechanical engineer.

Career–technical performance standards and model curriculum integrated performance activities for Engineering Technology are presented in this chapter. The reader should review career–technical standards concurrently with related career performance standards and academic performance standards, described fully in Chapter 2, "Industrial and Technology Education Model Curriculum Standards."

Career–Technical Performance Standards

Core

Standard 1: Drafting

Students will know how to plan, prepare, and interpret mechanical, civil, chemical, and electronic/electrical sketches and drawings. They will develop, plan, and produce well-proportioned and easily understood two- and three-dimensional sketches and drawings, using correct drafting tools, techniques, and media; and they will prepare reports and data sheets for writing specifications.

Standard 2: Computer-Aided Drafting

Students will understand how to use a computer, computer software, and peripheral devices to create an image or drawing in the design and documentation of an object. Students will apply appropriate software file-management procedures and produce hard copies of completed drawings for various graphic outputs.

Standard 3: Electronics

Students will know the fundamentals of the theory, measurement, control, and applications of electrical energy, including AC/DC, components with transistors, motors, and digital devices. Students will read and follow instructions, interpret schematics to set up experimental apparatuses, make measurements, test circuits, and record results.

Standard 4: Manufacturing

Students will understand the variety of materials, tools, and processes used in manufacturing. This understanding will introduce the student to the design, tooling, and assembly of industrial products. Students will demonstrate skills that involve hand and machine processes for the fabrication, analysis, or testing of metals, woods, and plastics.

Standard 5: Chemical

Students will understand the basic principles of chemistry and the scientific method; have a knowledge of chemical calculations; and be introduced to the study of organic and inorganic compounds. Students will demonstrate the ability to calculate formulas for compounds. Students also will demonstrate a knowledge of quantitative relationships, using dimensional and analytical analysis to solve problems.

Standard 6: Physics

The student will know the principles of physics in relation to the four energy systems: mechanical, fluid, thermal, and electrical. These four systems are examined through the units of force, work, rate, resistance, energy, power, force transformers, momentum, waves and vibrations, energy converters, transducers, radiation, optical systems, and time constants. Students will apply the laws of physics to solve problems that affect the students themselves and society at large.

Standard 7: Mechanics of Solids

Students will be familiar with scalar and vector quantities; forces; composition and resolution of forces; moments of force; principles of moments of force; couples; transformation of couples; resolution of a force and couple; dimensional equations; resultants of force systems; centers of gravity; equilibrium; friction; moments of inertia; absolute and relative motion; force, mass, and acceleration; work and energy; impulse; and momentum. Students can apply these principles to solve problems with construction and solids.

Standard 8: Mechanics of Fluids

Students will understand the properties of fluids; hydrostatic forces on surfaces; buoyancy and flotation; translation and rotation of liquid masses; dimensional analysis and hydraulic modeling; fundamentals of fluid flow; kinetic energy; application of the Bernoulli theorem; hydraulic grade line; power; fluid flow; and force developed by moving fluids and fluid machinery. Students will demonstrate skills by building a closed hydraulic or pneumatic system to generate motion from the flow of liquids or gases.

Standard 9: Mechanics of Heat and Sound

Students will understand the effects of heat; changes of state; calorimetry; thermal behavior of liquids and gasses; work and transfer of heat; wave motion; sound reproduction; sound reception and control; sources and velocity of light; reflection and refraction; dispersion; spectra and color; optical instruments; interference and diffraction; and polarized light. Students will demonstrate an understanding of heat and sound by choosing the proper components to make heat perform work or to produce sound from receivers.

Model Curriculum Integrated Performance Activities

Standards in all the industrial and technology education curriculum clusters are written as broad-based performance standards. Integrated performance activities describe classroom or workplace student activities that reflect two or more performance standards. They are specifically intended to provide instructors and curriculum developers with examples of activities designed to promote the student's acquisition of selected standards. Classroom teachers will have the option of using integrated performance activities as developed here or modifying them to fit local needs, objectives, or individual teaching styles.

A limited selection of integrated performance activities is provided in this document to facilitate an understanding of performance standards. Subsequent and companion handbooks or curriculum development guides will provide a complete reference to integrated performance activities for all industrial and technology education curriculum clusters. Integrated performance activities are subject to constant change, including additions, item corrections and rewrites, deletions, and the like. Integrated performance activities are subject to constant modification to keep pace with the changing needs of students, business and industry, and the educational milieu.

Integrated performance activities for Engineering Technology were under development at the time this document was published. Draft copies of an activities handbook are available on request from consultants listed on pages xiii and xiv.

Page 104 is blank.

Chapter 10

Graphic Communications Technology Standards

Standards in Graphic Communications Technology address various forms of visual communications that affect people in nearly every walk of life. Collectively, graphic communications technology standards provide a model for the development of graphic communications technology program curricula, from high school programs through lifelong instructional delivery systems, including retraining and upgrading programs. Curricula designed from these model standards prepare persons for employment or advanced training in a variety of related industries. Programs operating on standards-based curricula provide the workforce with technicians, technical report writers, and supervision managers.

Graphic Communications Technology programs in California provide students with the skills they need for entry-level positions directly out of high school and ROC/P; technical-level positions after community college; or professional-level positions after receiving a bachelor's degree. This sequence begins with a broad-based Introduction to the Graphic Communications course after completion of the Technology Core program. The career path sequence is then tailored to each student's goal by providing opportunities to enroll in such programs as Printing Technology, Advertising Design, Commercial Photography, and Multimedia.

Graphic Communications Technology education programs form a powerful integrated linkage with all other disciplines. Knowledge and skills across the disciplines are enhanced and reinforced, enabling students to compete in the workforce and become productive citizens in our society. Those programs are provided within the context of a total, sequential program in which students will be able to plan intelligently and prepare properly for a career goal.

In Graphic Communications programs, students use mathematical skills, such as estimation and problem solving, by applying algebraic, geometric, and trigonometric formulas and functions. Students practice communications by applying reading, writing, listening, speaking, visual, and nonverbal skills. Students also learn and practice scientific principles that apply to mechanical, fluid, thermal, electronic, and electrical systems. Those scientific principles include force, work, rate, resistance, energy, power, and momentum.

Graphic Communications Technology students also learn and use skills based on principles of design, electronics, and manufacturing. Examples of those skills include layout and design; manipulation of electronic data; an understanding of mechanical, hydraulic, and pneumatic operations; manufacturing; and an understanding of machine operations and processes. This interdisciplinary approach provides students with strong foundation skills and advanced-level skills in the career field of their choice which allow them to exit programs at selected points and enter identified occupations or advanced training.

The Graphic Communications Technology standards cover the development of graphic communications skills and integrated skills from the general or exploratory to the occupational specific, providing a path in which students can develop to their greatest potential and prepare to achieve postsecondary goals. All students have the right to select a career path directly related to their particular career and personal goals and receive education and training to make their goals possible. Students are able to take the necessary

prerequisite courses for their chosen paths by developing their own individualized plan. Bridges exist to help students move from one path to another as they mature and develop through their high school years.

Career–technical performance standards and model curriculum integrated performance activities for Graphic Communications Technology are presented in this chapter. The reader should review career–technical standards concurrently with related career performance standards and academic performance standards, described fully in Chapter 2, "Industrial and Technology Education Model Curriculum Standards."

Career–Technical Performance Standards

Standard 1: Introduction to the Graphic Communications Industry

Students will understand the composition and functions of the graphic communications industry (types of companies, markets, occupations, and so forth) and the production flow of the printing process, from initial need to finished product and marketing. Students will perform the basic operations required in various graphic communications industries.

Standard 2: Graphic Design

Students will understand the application of basic graphic design principles (layout, color, typography, art, and copy preparation) to achieve specific goals—to persuade, communicate, identify, attract attention, or create action. They will produce thumbnail sketches, rough layouts, and a comprehensive layout for a printed product.

Standard 3: Desktop/Electronic Publishing

Students will understand the function and application of desktop publishing software (word processing, graphics, page layout, and so forth). They will prepare camera-ready layouts for various printed products.

Standard 4: Art and Copy Preparation

Students will understand art and copy preparation (specification of type, scaling of art, paste-up, mechanical color, and so forth). They will produce various camera-ready paste-ups for single-color and multicolor printed products.

Standard 5: Reproduction Photography

Students will understand reproduction photography procedures required for single-color and multicolor printing (line work, halftones, special effects, and so forth). They will produce line, halftone, and special-effect negatives, stats, and contact prints for pasteup and image assembly.

Standard 6: Image Assembly and Platemaking

Students will understand the procedures involved in single-color and multicolor image assembly and platemaking (layout of the flat, blue-line and color proofing, subtractive plate processing, and so forth). They will prepare flats, proofs, and plates for single-color and multicolor printing.

Standard 7: Press Operations

Students will understand the function of the offset press and the factors affecting its performance (paper stock, inks, dampening solution, and so forth). They will set up and print single-color and multicolor products and ensure a minimum of waste.

Standard 8: Binding and Finishing

Students will understand the binding and finishing processes (folding, stitching, trimming, and so forth). They will bind and finish notepads, brochures, booklets, business cards, and other printed products.

Standard 9: Commercial Photography

Students will understand the photographic process (lighting, exposure, printmaking, and so forth). Under natural and studio lighting conditions, they will produce black-and-white and color prints and slides of various subjects.

Standard 10: Multimedia

Students will understand the characteristics and uses of various types of nonprint media. Using current technology, they will produce a media project designed to inform, teach, or sell.

Standard 11: Screen Printing

Students will understand the screen printing process (image preparation, printing, finishing, and so forth). They will print products on various substrates, using appropriate inks and procedures.

Standard 12: Safety and Health in the Graphic Communications Industry

Students will understand the proper health and safety guidelines for each mechanical working area, including the storage and recycling of raw materials and waste products. They will describe the health and safety precautions to take in the graphic arts laboratory; procedures for storing and using materials and chemicals; power equipment and hand tools; and the classification of fires and the fire-fighting treatments for those classifications. Students will define OSHA regulations that apply to printing and publishing.

Model Curriculum Integrated Performance Activities

Standards in all the industrial and technology education curriculum clusters are written as broad-based performance standards. Integrated performance activities describe classroom or workplace student activities that reflect two or more performance standards. They are specifically intended to provide instructors and curriculum developers with examples of activities designed to promote the student's acquisition of selected standards. Classroom teachers will have the option of using the integrated performance activities as developed here or of modifying them to fit local needs, objectives, or individual teaching styles.

A limited selection of integrated performance activities is provided in this document to facilitate an understanding of performance standards. Subsequent and companion handbooks or curriculum development guides will provide a complete reference to integrated performance activities for all industrial and technology education curriculum clusters. Integrated performance activities are subject to constant change, including additions, item corrections and rewrites, deletions, and the like. Integrated performance activities are subject to constant modification to keep pace with the changing needs of students, business and industry, and the educational milieu.

Selected activities are as follows (draft copies of an activities handbook are available on request from consultants listed on pages xiii and xiv):

Activity 1: The Basic Printing Process

Students design a basic printed product, such as a note pad, that includes type and line art. They specify the type style; select clip art; and specify the appropriate paper stock, ink color, binding and finishing methods, and quantity. They prepare a job jacket/ticket. They produce the type; prepare a stat of the line art; rule out the dimensions on art board and paste up the copy and art; make a line negative; strip up the negative on pre-ruled masking sheets; prepare a foil plate; print the specified quantity; and bind and finish the pads. Then students write a summary of the design and production process, list the equipment and materials used, and evaluate the quality of the finished product.

Graphic Standards	1, 2, 3, 4, 5, 6, 7, 8
Career Performance Standards	1, 3, 4, 5, 7
Academic Performance Standards	10, 22, 40

Activity 4: Press and Bindery Operations

Teams of three or four students are given a job jacket/ticket with printing plates and specifications for a letterhead, flier, brochure, booklet, or other printed product. They select the specified paper stock and ink colors, set up and adjust the printing press, and print a press proof that meets approval of the team leader or the instructor (or both). As they complete the press run, students make appropriate adjustments for waste, basing their adjustments on the number of passes through the press and the complexity of the binding and finishing operations. After the run has dried, students fold, gather, stitch, glue, drill, trim, and so forth, as specified for the particular job. They count, package, and deliver the finished product; sign off the job ticket; and file the job jacket for future use. Each student maintains a personal log of each job by recording the procedures, equipment, tools, and materials used.

Graphic Standards	1, 7, 8, 12
Career Performance Standards	1, 2, 3, 4, 5, 6, 7
Academic Performance Standards	10, 11, 21, 22, 40

Activity 6: Production of a Custom-Printed Product

Working in teams of three or four, students produce such custom-printed products as personalized notepads, personalized stationery, business cards, brochures, Christmas cards, return address labels, and so forth. One team solicits orders from the school community, including students, staff, and parents. The sales-team members prepare sample books of the paper and card stocks available. They label each stock sample with the brand name, weight, color, and available sizes. They prepare a type-specimen catalog of the styles producible on the print shop's equipment.

Students obtain ink color charts from the manufacturer and check stock for available colors. They compile portfolios representative of products that have been produced by the print shop. They assist clients in designing the product and selecting appropriate type styles, artwork, paper stock, and ink colors. They estimate prices, using pricing charts or computerized estimating programs; provide written price quotes; and write orders. Another team of students prepares the job jacket/ ticket; orders the necessary supplies; and monitors the production schedule and quality of work as the job progresses through the shop. Production work is done by the copy preparation, pre-press, and press/bindery teams. Income from sales is used to replenish supplies and maintain and upgrade equipment.

Graphic Standards	1, 2, 3, 4, 5, 6, 7, 8, 12
Career Performance Standards	1, 2, 3, 4, 5, 6, 7
Academic Performance Standards	10, 11, 21, 22, 40

Activity 9: Commercial Photography Portfolio

Students research the characteristics of a good commercial photographer's portfolio, or "book," and prepare a portfolio of their own, including prints in black-and-white and in color. They photograph various subjects under natural and studio lighting conditions, taking measurements and making calculations to ensure that the film is exposed correctly. Students then process and print the negatives and prepare the print for inclusion in the portfolio. Students write a description of the subject; lighting conditions; the camera and film used to make the exposure; film processing and printing equipment and procedures used; the paper stock, developer, and toner used; and the method of mounting selected. Students also write a self-evaluation, addressing each photo in their portfolios.

Graphic Standards	4, 9, 12
Career Performance Standards	1, 2, 3, 4, 5, 6, 7
Academic Performance Standards	3, 10, 11, 20, 22, 40

Activity 14: Stock-Screen Printing Production

Working in teams of three or four, students develop, produce, and market stock-screen printed products, such as caps, T-shirts, sweatshirts, bumper stickers, labels, posters, cards, and so forth. One team surveys the local market (the school community, including students, staff, and parents), develops the ideal, prepares the design, and specifies the type and art to be used. Another team prepares the job jacket/ticket, orders the necessary supplies, and monitors the production schedule and quality of work as the job progresses through the shop. Production work is done by a screen-printing production team. A sales team markets the product, which may be sold by the print-shop class or by the student store (or both). The team develops promotional materials for bulletin boards and staff mail boxes and places advertisements in the Parent-Teacher-Student Association newsletter. Team members also publicize the project (and the print class's role in its production) by preparing a press release for local newspapers and the school newspaper. Income from sales is used to replenish supplies and maintain and upgrade equipment.

Graphic Standards	3, 4, 5, 11
Career Performance Standards	1, 2, 3, 4, 5, 6, 7
Academic Performance Standards	3, 10, 11, 21, 22, 40

Activity 18: Multimedia

Students, working individually or in small groups, produce a basic multimedia project, such as a video production or hyper-media stack designed to inform, teach, or sell. They select the media, write the copy, prepare the script (story board), and select images to produce the finished project. Each student maintains a log of activities and durations. Each students also prepares a written summary of the design and production processes, a list of the equipment and materials used, and an evaluation of the finished product's quality and effectiveness in meeting its purpose.

Graphic Standards	1, 2, 3, 4, 5, 9, 10, 12
Career Performance Standards	1, 2, 3, 4, 7
Academic Performance Standards	10, 11, 20, 21, 22, 40

Chapter 11

Manufacturing Technology Standards

Standards in manufacturing technology address an introduction to manufacturing technology core, manufacturing systems, manufacturing processes and an advanced section in welding processes, machine tool processes, and manufacturing enterprise. Collectively, Manufacturing Technology standards provide a model for the development of manufacturing technology program curricula for high school programs through lifelong instructional delivery systems, including retraining programs and programs for upgrading of skills. Curriculum designed from these model standards prepares persons for employment or advanced training in a variety of industries.

Manufacturing Technology programs in California provide students with the skills to enter the workforce in an entry-level position directly out of high school and ROC/P, at the technical level after community college, or at the professional level after receiving a bachelor's degree. This sequence begins after the Technology Core program, with a broad-based course, Introduction to Manufacturing, followed by a sequence of courses in advanced manufacturing. The career path sequence is then tailored to each student's goal by providing the student the opportunity to enroll in such programs as Machine Tool, Welding, Fabrication, and Synthetics.

Manufacturing Technology education programs form a powerful and positive, integrated linkage with all other disciplines. Knowledge and skills across disciplines are enhanced and reinforced, enabling students to compete in the U.S. economy as productive citizens. These programs are provided in the context of a complete sequential program, in which students are able to plan intelligently and prepare properly for a career goal.

In the manufacturing program students use mathematical skills, such as estimating and problem solving, in the application of algebraic, geometric, and trigonometric formulas and functions. Students practice communications by applying reading, writing, listening, speaking, visual, and nonverbal skills. Students also learn and practice scientific principles that apply to mechanical, fluid, thermal, electronic, and electrical systems. These scientific principles include the principles of force, work, rate, resistance, energy, power, and momentum.

Manufacturing Technology students also use construction, graphic communications, electronic, transportation, manufacturing, and energy principles. Sample skills include construction design; infrastructure design; tool design; graphic illustrations; electronic circuit-board design; mechanical, hydraulic, and pneumatic operations; and other skills needed for employment in the twenty-first century. These interdisciplinary approaches provide students with strong foundation skills and with advanced-level skills in the career field of their choice, skills which allow students to exit programs at selected points and enter into identified occupations or advanced training.

The Manufacturing Technology standards cover the development of manufacturing skills and integrated skills, from the general or exploratory to the occupational specific, providing a path in which students can develop to their greatest potential and be prepared to achieve postsecondary goals. All students have the right to select a career path directly related to their particular career and personal goals, and receive education and training to make their goals possible. Students are able to take the necessary prerequisite

courses for their chosen paths by developing their own individualized plan. Bridges exist to help students move from one path to another as they mature and develop through their high school years.

Career–technical performance standards and model curriculum integrated performance activities for Manufacturing Technology are presented in this chapter. The reader should review career–technical standards concurrently with related career performance standards and academic performance standards, described fully in Chapter 2, "Industrial and Technology Education Model Curriculum Standards."

Career–Technical Performance Standards

Introduction to Manufacturing Technology

Core

Standard 1: Planning and Layout Processes

Students will understand the planning and layout processes (designing, print reading, measuring, and so forth) used in manufacturing. They will read prints and use information from the prints to plan, lay out, and produce parts or products.

Standard 2: Materials Processing

Students will understand how materials can be processed through the use of tools and machines. They will use tools and the processes of cutting materials, shaping them, combining them, forming them, and so forth, to manufacture parts or products.

Standard 3: Assembling Processes

Students will understand various types of assembling processes (mechanical fastening, mechanical force, joining, fusion bonding, adhesive bonding, and so forth) used in manufacturing. They will apply appropriate fastening or joining procedures to the design and production of manufactured parts or products.

Standard 4: Finishing Processes

Students will understand finishing processes (surface preparation, methods of application, and so forth) and the differences between various types of finishing materials used in manufacturing. They will select an appropriate finishing process for a product in accordance with the product's purpose, the environment in which it will function, and its aesthetic appeal.

Standard 5: Quality Control

Students will understand the purposes and processes of inspection and quality control in the manufacturing process. They will perform continuous on-line inspections to ensure that parts and products meet design specifications.

Systems

Standard 6: Conventional Manufacturing Systems

Students will understand various manufacturing systems that require standard hand and machine tools. They will select and use appropriate conventional tools, machines, and inspection devices to manufacture parts or products.

Standard 7: Automated Manufacturing Systems

Students will understand and explain various automated manufacturing systems (such as "just in time"), tool design, design for manufacturing, flexible manufacturing systems, and materials resource planning. They will use computers to design and produce products, control robots, and machines and to write numerical-control programs.

Standard 8: New and Emerging Technology Systems

Students will understand the ongoing development of emerging manufacturing technology systems. They will explain the ways in which emerging systems can be integrated into current manufacturing processes.

Processes

Standard 9: Welding Processes

Students will understand various welding machines and welding processes (gas welding and cutting, brazing, resistance welding, and arc welding) used in manufacturing, maintenance, and repair. They will perform welding processes to complete a fabrication, assembly, or repair in accordance with practices prescribed by the American Welding Society.

Standard 10: Machine-Tool Processes

Students will understand the operation and functions of machine tools in production and prototype work. They will select appropriate processes and machines to produce or manufacture parts or products efficiently.

Standard 11: Industrial Forming

Students will understand industrial forming processes and their application to specific types of materials. They will produce a part or manufacture a product, using appropriate casting, forging, molding, cold forming, and shearing processes.

Enterprise

Standard 12: Organization of a Manufacturing Enterprise

Students will understand how a manufacturing company is organized. They will develop a corporate structure that includes financing, management, and marketing systems.

Standard 13: Production Technology and Management

Students will understand the elements of production management. They will establish a management system that includes planning, engineering, organizing, actuating, and controlling resources and manufacturing processes.

Welding Processes

Standard 14: Product Development and Documentation

Students will understand the basic elements of proper product or project development and documentation (including estimating, codes and specifications, sketching, material and process selection, and print reading) used in welding design. They will read and interpret prints which use standard American Welding Society welding symbols to plan, lay out, and produce welded parts and products.

Standard 15: Variables in Welding Fabrication

Students will understand the chemical, physical, and mechanical properties of welding materials and how welding processes affect those properties. Students will produce weldments, using proper preparation procedures and welding processes to counteract and minimize such undesirable defects as corrosion, oxidation, distortion, stress, and arc blow.

Standard 16: Industrial Forming for Welding Fabrication

Students will understand the safe and efficient use of shears, saws, drilling machines, punches, benders, and presses used in welding fabrication. They will use appropriate industrial forming tools to prepare parts and to ensure proper fit and finish.

Standard 17: Oxyfuel Gas Processes

Students will understand the safe and efficient use of oxyfuel processes and equipment to form, separate, and combine metals. They will use the oxyfuel processes of forging, flame cutting, brazing, soldering, and welding to produce parts and products.

Standard 18: Shielded Metal Arc Welding (SMAW)

Students will understand the functions of shielded metal arc welding machines and consumables and how the equipment used in those functions is properly assembled and set up for various applications. The students will produce weldments, using appropriate machine setup and electrode types as indicated by material type and size, weld position, joint alignment and type, deposition rate, and bead finish.

Standard 19: Gas Metal Arc Welding (GMAW)

Students will have a basic understanding of the machines and consumables used in gas metal arc welding and similar processes. They will produce weldments, using the appropriate shielding gas, wire type and size, type of metal transfer, and machine setup as indicated by type and thickness of metal, weld position, penetration, and type of weld bead.

Standard 20: Gas Tungsten Arc Welding (GTAW)

Students will have a basic understanding of the machines and supplies used in the gas tungsten arc welding process. They will produce weldments, using appropriate joint preparation; machine setup; filler material; electrode size, type, and shape; and shielding gas type and flow as indicated by type and thickness of metal, weld position, type of joint, and the welding environment.

Standard 21: Resistance Welding

Students will understand the principles of electric resistance and the methods used in resistance welding. They will select the appropriate electrode type, electrode force, squeeze time, and current settings to complete joints of a product, using resistance or "spot" welding.

Standard 22: Special Processes

Students will have a basic understanding of special processes for welding or cutting unusual materials, extremely thick materials, or very thin metals; increasing productivity; and operating in unusual conditions or locations. They will identify special welding or cutting processes (SMAW underwater, plastics welding, friction welding, FRW electron beam, EBW industrial robots, plasma-arc cutting[PAC], and so forth); describe circumstances in which those processes are used; and explain the advantages and disadvantages of each.

Standard 23: Pipe and Tube Welding

Students will have a basic understanding of the manner in which pipe and tubing joints (V-grove, butt, T-, and K-and-T connections) are prepared and completed. They will lay out, fit, and join sample pipe or tubing joints, using proper shielded-metal arc-welding procedures and techniques.

Standard 24: Inspection, Testing, and Certification

Students will understand common types of weld tests, how to identify a flaw, and what constitutes a defect. They will perform visual inspections of their welds; prepare and perform selective destructive and nondestructive tests to determine dimensional accuracy; and identify undercut, overlap, porosity, tensile strength, hardness, and shear strength.

(Note on welding: All evaluations of student performance will be based on the standards of the American Society of Mechanical Engineers or the American Welding Society, or both.)

Machine-Tool Processes

Standard 25: Tolerance and Dimensioning

Students will understand concepts of dimensioning. They will follow industry-approved dimensioning standards, using geometric tolerance and drawing interpretation skills when machining parts or products.

Standard 26: Holding Devices

Students will understand how to use machine-tooling holding devices. Using safe practices, students will use fixtures, vices, rotary devices, chucks, and hold-down clamps to secure the work in a machine-tool operation.

Standard 27: Conventional Lathe

Students will understand the safe and proper operation of the conventional lathe. They will use industry-approved tooling, setups, feeds, cutting speeds, and manufacturing techniques to manufacture parts or products on the lathe.

Standard 28: Conventional Milling Machine

Students will understand the safe and proper operation of the conventional milling machine. They will use industry-approved applications or tooling, setups, feeds, cutting speeds, and machining techniques to manufacture parts or products on the milling machine.

Standard 29: Grinders and Grinding Wheels

Students will understand the safe and proper operation of grinders. Using safe practices, students will select and test grinding wheels for specific machines and applications, using industry-approved standards. They will use pedestal grinders and surface grinders to manufacture and finish grind parts or products.

Standard 30: Precision Instruments

Students will understand how precision instruments are used in the manufacture of parts or products. They will use precision instruments to inspect machine products or parts in accordance with the standards prescribed by the American National Standards Institute.

Standard 31: Parts Layout and Inspection

Students will understand layout work using industry-approved standards. They will lay out, machine, and inspect manufactured parts and castings.

Standard 32: Foundry and Casting

Students will understand foundry and casting practices in relation to manufacturing processes. They will use industry-approved foundry molding and casting techniques to make parts or products to be machined.

Standard 33: Sheet Metal

Students will understand the use of hand tools and machines for fabricating and forming sheet metal. They will use patterns, shears, brakes, bar folders, and forming rolls to shape sheet metal into parts or products to be used in manufacturing processes.

Enterprise

Standard 34: Organization of a Manufacturing Enterprise

Students will understand workplace functions in all aspects of a manufacturing organization. They will perform the organizational functions of a manufacturing enterprise, including site management, finance operations, marketing, community relations, and labor relations.

Standard 35: Manufacturing Enterprise Organizational Systems

Students will understand that manufacturing is an integrated system. They will use project-based learning to integrate all aspects of a manufacturing organization in creating a system that carries a product from its inception to its sale.

Model Curriculum Integrated Performance Activities

Standards in all the industrial and technology education curriculum clusters are written as broad-based performance standards. Integrated performance activities describe classroom or workplace student activities that reflect two or more performance standards. They are specifically intended to provide instructors and curriculum developers with examples of activities designed to promote the student's acquisition of selected standards. Classroom teachers will have the option of using the integrated performance activities as developed here or of modifying them to fit local needs, objectives, or individual teaching styles.

A limited selection of integrated performance activities is provided in this document to facilitate an understanding of performance standards. Subsequent and companion handbooks or curriculum development guides will provide a complete reference to integrated performance activities for all industrial and technology education curriculum clusters. Integrated performance activities are subject to constant change, including additions, item corrections and rewrites, deletions, and the like. Integrated performance activities are subject to constant modification to keep pace with the changing needs of students, business and industry, and the educational milieu.

Selected activities are as follows (draft copies of an activities handbook are available on request from consultants listed on pages xiii and xiv):

Activity 2: Automated and Emerging Technology

A group of five to six students is given the following automated manufacturing system topics: computer-aided design (CAD), computer-aided manufacturing (CAM), robotics, flexible manufacturing, and artificial intelligence. Using available resources (videos, textbooks, manufacturers' literature, the school library, and so forth), each student researches an assigned or selected topic and prepares a written and oral report that includes a brief history of the automated manufacturing system and discusses its advantages and disadvantages, the equipment required, applications for the process, and the safety hazards involved.

Manufacturing Standards	7, 8
Career Performance Standards	1, 2, 4, 5
Academic Performance Standards	20, 21, 22, 40

Activity 3: Conventional Manufacturing

Given an existing drawing, students individually plan the manufacturing sequences and select and use the proper procedures for the layout, casting, forming, machining, and assembly of materials required to manufacture a product, such as a hand hacksaw tool tray, gear puller, or any other appropriate metalworking project that includes conventional manufacturing processes. As a part of the self evaluating process, students present an oral report on the planning and manufacturing processes and assess the quality of the product.

Manufacturing Standards	1, 2, 3, 5, 6, 10, 11, 13
Career Performance Standards	1, 3, 4, 5
Academic Performance Standards	21, 22

Activity 4: Planning and Layout

Students in groups of three are provided with a working drawing of a small paper punch. The students plan and develop a sequence chart, plotting the steps required to manufacture all parts. They select the appropriate tools and required manufacturing processes. Students make oral presentations of their proposals for manufacturing the paper punch, using their final sequence charts.

Manufacturing Standards	1, 2, 3, 5, 6, 10, 13
Career Performance Standards	2, 3, 4
Academic Performance Standards	10, 20, 21, 22

Activity 5: Production and Management

Students form a corporation among themselves and select a product from a given list. Using drafting tools or computer-graphics programs, they create a management-team hierarchy that includes a chief executive officer, board of directors, and managers. The students also design a plan to finance, manufacture, and market their product.

Manufacturing Standards	1, 5, 6, 7, 10, 12, 13
Career Performance Standards	2, 4, 5, 7
Academic Performance Standards	10, 20, 21, 22, 40

Activity 6: Tool Design

Working groups of two or three, students design a drill jig for a part that requires an eight-inch diameter bolt circle with six evenly spaced one-quarter-inch-diameter holes. The drill-jig design is to include adequate clamping devices, proper drill bushings, and accurate locators. Each group presents a summary of their design to the class.

Manufacturing Standards	1, 2, 3, 4, 5
Career Performance Standards	2, 3, 4, 5
Academic Performance Standards	10, 13, 20, 21, 22, 30

Activity 8: Planning Production

Teams of three or four students are assigned a set of drawings, specifications, and manufacturing operations for a product. (The product should require machining, fabrication, and forming operations). Using a computer, the team develops a master-production flowchart that includes the following information:

1. Tools and equipment required for the manufacturing operations
2. Type of materials and finishes required
3. How the product will be transported from one workstation to the next
4. Inspections to be performed

Each team prepares a summary of the production flowchart and presents its findings to the class.

Manufacturing Standards	1, 2, 3, 4, 5, 6, 9, 10, 11, 13
Career Performance Standards	2, 3, 4, 5
Academic Performance Standards	10, 20, 21, 22, 30