

# Course Outline

**Transportation**

**REVISED: August/2020**

**Job Title**

Auto Technician

**79-90-69**

**Career Pathway:**

Systems Diagnostics and Service

**Auto Tech: Engine Performance/1**

**Industry Sector:**

Transportation

**Credits:** 15

**Hours:** 180

**O\*NET-SOC CODE:**

49-3023.02

**Course Description:**

This competency-based course is one in a sequence of courses designed to meet the Automotive Service Excellence (ASE) Program Certification Standards set by the National Automotive Technicians Education Foundation (NATEF). It provides students with technical instruction and practical experience in an automobile area incorporating sustainable and green vehicle technologies. Instruction includes classroom and workplace policies and procedures in accordance with federal, state, and local safety and environmental regulations. It covers the proper use, maintenance, and storage of auto repair tools and equipment, the effective use of service manuals and computer-based information systems, and an introduction to the different engine designs, automotive electricity, hybrid vehicles, and alternative fuel vehicles. Emphasis is placed on the techniques in the following areas of engine performance diagnosis and repair: general, computerized engine controls, and ignition system. It also teaches trade mathematics, resource management, and employability skills. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

**CBEDS Title:**

Advanced Automotive

**Prerequisites:**

Enrollment requires successful completion of the Auto Tech: Engine Repair (79-90-73) course.

**NOTE:** For Perkins purposes this course has been designated as an **introductory/concentrator** course.

MEETS NATEF STANDARDS AND IDENTIFIES PRIORITY TASKS IN ENGINE PERFORMANCE. CHECK THE NATEF MANUAL FOR EXPLANATION OF PRIORITY 1, 2, OR 3 TASKS.

This course cannot be repeated once a student receives a Certificate of Completion.

Los Angeles Unified School District  
Division of Adult and Career Education  
Instructional and Counseling Services Unit  
Adult Curriculum Office  
www.wearedace.org



## **COURSE OUTLINE COMPETENCY-BASED COMPONENTS**

A course outline reflects the essential intent and content of the course described. Acceptable course outlines have six components. (Education Code Section 52506). Course outlines for all apportionment classes, including those in jails, state hospitals, and convalescent hospitals, contain the six required elements:

(EC 52504; 5CCR 10508 [b]; Adult Education Handbook for California [1977], Section 100)

### **COURSE OUTLINE COMPONENTS**

### **LOCATION**

#### **GOALS AND PURPOSES**

Cover

The educational goals or purposes of every course are clearly stated, and the class periods are devoted to instruction. The course should be broad enough in scope and should have sufficient educational worth to justify the expenditure of public funds.

The goals and purpose of a course are stated in the COURSE DESCRIPTION. Course descriptions state the major emphasis and content of a course and are written to be understandable by a prospective student.

#### **PERFORMANCE OBJECTIVES OR COMPETENCIES**

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Objectives should be delineated and described in terms of measurable results for the student and include the possible ways in which the objectives contribute to the student's acquisition of skills and competencies.

Performance Objectives are sequentially listed in the COMPETENCY-BASED COMPONENTS section of the course outline. Competency Areas are units of instruction based on related competencies. Competency Statements are competency area goals that together define the framework and purpose of a course. Competencies fall on a continuum between goals and performance objectives and denote the outcome of instruction.

Competency-based instruction tells a student before instruction what skills or knowledge they will demonstrate after instruction. Competency-based education provides instruction which enables each student to attain individual goals as measured against pre-stated standards.

Competency-based instruction provides immediate and continual repetition and in competency-based education the curriculum, instruction, and assessment share common characteristics based on clearly stated competencies. Curriculum, instruction, and assessment in competency-based education are explicit, known, agreed upon, integrated, performance oriented, and adaptive.

**COURSE OUTLINE COMPETENCY-BASED COMPONENTS**  
**(continued)**

**COURSE OUTLINE COMPONENTS**

**LOCATION**

**INSTRUCTIONAL STRATEGIES**

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Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.

Instructional strategies for this course are listed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructional strategies and activities for a course should be selected so that the overall teaching approach takes into account the instructional standards of a particular program, i.e., English as a Second Language, Programs for Adults with Disabilities.

**UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT**

Cover

The approximate time devoted to each instructional unit within the course, as well as the total hours for the course, is indicated. The time in class is consistent with the needs of the student, and the length of the class should be that it ensures the student will learn at an optimum level.

pp. 7-15

Units of study, with approximate hours allotted for each unit are listed in the COMPETENCY AREA STATEMENT(S) of the course outline. The total hours of the course, including work-based learning hours (community classroom and cooperative vocational education) is listed on the cover of every CBE course outline. Each Competency Area listed within a CBE outline is assigned hours of instruction per unit.

**EVALUATION PROCEDURES**

pp. 18-19

The evaluation describes measurable evaluation criteria clearly within the reach of the student. The evaluation indicates anticipated improvement in performances as well as anticipated skills and competencies to be achieved.

Evaluation procedures are detailed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructors monitor students' progress on a continuing basis, assessing students on attainment of objectives identified in the course outline through a variety of formal and informal tests (applied performance procedures, observations, and simulations), paper and pencil exams, and standardized tests.

**REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT**

Cover

After a student has completed all the objectives of the course, he or she should not be allowed to reenroll in the course. There is, therefore, a need for a statement about the conditions for possible repetition of a course to prevent perpetuation of students in a particular program for an indefinite period of time.

## ***ACKNOWLEDGMENTS***

Thanks to LUZ GRANADOS for developing and editing this curriculum. Acknowledgment is also given to ERICA ROSARIO for designing the original artwork for the course covers.

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# **CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS**

## ***Transportation Industry Sector Knowledge and Performance Anchor Standards***

### **1.0 Academics**

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Transportation academic alignment matrix for identification of standards.

### **2.0 Communications**

Acquire and accurately use Transportation sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

### **3.0 Career Planning and Management**

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

### **4.0 Technology**

Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the Transportation sector workplace environment.

### **5.0 Problem Solving and Critical Thinking**

Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Transportation sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

### **6.0 Health and Safety**

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Transportation sector workplace environment.

### **7.0 Responsibility and Flexibility**

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Transportation sector workplace environment and community settings.

### **8.0 Ethics and Legal Responsibilities**

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

### **9.0 Leadership and Teamwork**

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organization

### **10.0 Technical Knowledge and Skills**

Apply essential technical knowledge and skills common to all pathways in the Transportation sector, following procedures when carrying out experiments or performing technical tasks.

### **11.0 Demonstration and Application**

Demonstrate and apply the knowledge and skills contained in the Transportation anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organization.

## ***Transportation Pathway Standards***

### **C. Systems Diagnostics and Service Pathway**

The Systems Diagnostics and Service pathway prepares students for postsecondary education and employment in the transportation industry, which includes but is not limited to motor vehicles, rail systems, marine applications, and small-engine and specialty equipment.

Sample occupations associated with this pathway:

- ◆ Service Technician/Maintenance Worker/Shop Foreman
- ◆ Technical Writer
- ◆ Dispatcher
- ◆ Engineer
- ◆ Investigator/Inspector

- C1.0 Demonstrate the practice of personal and occupational safety and protecting the environment by using materials and processes in accordance with manufacturer and industry standards.
- C2.0 Practice the safe and appropriate use of tools, equipment, and work processes.
- C3.0 Use scientific principles in relation to chemical, mechanical, and physical functions for various engine and vehicle systems.
- C4.0 Perform and document maintenance procedures in accordance with the recommendations of the manufacturer.
- C5.0 Apply and understand appropriate business practices.
- C6.0 Demonstrate the application, operation, maintenance, and diagnosis of engines, including but not limited to two- and four-stroke and supporting subsystems.
- C7.0 Demonstrate the function, principles, and operation of electrical and electronic systems using manufacturer and industry standards.
- C8.0 Demonstrate the function and principles of automotive drivetrain, steering and suspension, brake, and tire and wheel components and systems in accordance with national industry standards.

**CBE**  
**Competency-Based Education**

**COMPETENCY-BASED COMPONENTS**  
**for the Auto Tech: Engine Performance/1 Course**

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. ORIENTATION AND SAFETY</p> <p>Understand, apply, and evaluate classroom and workplace policies and procedures used in accordance with federal, state, and local safety and environmental regulations.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe the scope and purpose of the course.</li> <li>2. Describe classroom policies and procedures.</li> <li>3. Identify classroom and workplace first aid and emergency procedures.</li> <li>4. Describe the different occupations in the Transportation Industry Sector which have an impact on the role of the auto technician.</li> <li>5. Describe the California Occupational Safety and Health Administration (Cal/OSHA) workplace requirements for auto technicians.</li> <li>6. Explain the impact of Environmental Protection Agency (EPA) legislation on Transportation Industry Sector practices in protecting and preserving the environment.</li> <li>7. Explain the impact of California Air Resources Board (ARB) legislation on Transportation Industry Sector practices in protecting and preserving the environment.</li> <li>8. State the Bureau of Automotive Repair (BAR) standards for safety and environmental protection.</li> <li>9. Describe and demonstrate the use of the Material Safety Data Sheet (MSDS) as it applies to the automotive industry.</li> <li>10. Identify the safety items required by federal, state, and local regulations.</li> <li>11. Describe the role of the National Automotive Technicians Education Foundation (NATEF) in auto technician training.</li> <li>12. Describe and demonstrate the NATEF standards regarding proper use of protective clothing and gloves in an auto shop.</li> <li>13. Describe and demonstrate the NATEF standards regarding proper use of protective respiratory gear in an auto shop.</li> <li>14. Describe and demonstrate the NATEF standards regarding proper use of protective eye gear in an auto shop.</li> <li>15. Describe and demonstrate the NATEF standards regarding proper ventilation in an auto shop.</li> <li>16. Describe and demonstrate NATEF standards regarding proper handling, storage, and disposal of chemicals and materials used in an auto shop.</li> <li>17. Describe electrical/hybrid vehicle safety</li> <li>18. Pass the safety exam with 100% accuracy.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 6, 7, 12</p> <p><b>CTE Anchor:</b> Career Planning and Management: 3.4 Health and Safety: 6.1, 6.3, 6.5, 6.6, 6.7 Ethics and Legal Responsibilities: 8.2 Demonstration and Application: 11.2</p> <p><b>CTE Pathway:</b> C1.1, C1.2, C1.3, C1.4, C5.2</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p><b>B. RESOURCE MANAGEMENT</b></p> <p>Understand, apply, and evaluate the resource management principles and techniques in the auto repair and maintenance business.</p> <p>(2 hours)</p>	<ol style="list-style-type: none"> <li>1. Define the following:               <ol style="list-style-type: none"> <li>a. resources</li> <li>b. management</li> <li>c. sustainability</li> </ol> </li> <li>2. Describe the management of the following resources in the auto repair and maintenance business:               <ol style="list-style-type: none"> <li>a. time</li> <li>b. materials</li> <li>c. personnel</li> </ol> </li> <li>3. List specific examples of effective management of the following in the auto repair and maintenance business:               <ol style="list-style-type: none"> <li>a. time</li> <li>b. materials</li> <li>c. personnel</li> </ol> </li> <li>4. Describe the benefits of effective resource management in the auto repair and maintenance business:               <ol style="list-style-type: none"> <li>a. profitability</li> <li>b. sustainability</li> <li>c. company growth</li> </ol> </li> <li>5. Describe the economic benefits and liabilities of managing resources in an environmentally responsible way.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 8</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3 Problem Solving and Critical Thinking: 5.1 Responsibility and Flexibility: 7.1, 7.4, 7.6</p> <p><b>CTE Pathway:</b> C5.4</p>
<p><b>C. TRADE MATHEMATICS</b></p> <p>Understand, apply, and evaluate the mathematical requirements used in auto diagnosis, maintenance, and repair.</p>	<ol style="list-style-type: none"> <li>1. Identify the practical applications of math in auto repair and maintenance.</li> <li>2. Describe and demonstrate problem-solving techniques involving whole number problems, using addition, subtraction, multiplication, and division.</li> <li>3. Describe and demonstrate problem-solving techniques involving various fraction problems, using arithmetic operations (addition, subtraction, multiplication, and division).</li> <li>4. Describe and demonstrate problem-solving techniques involving various decimal problems, using arithmetic operations.</li> <li>5. Describe and demonstrate techniques for changing fractions to decimals.</li> <li>6. Describe and demonstrate techniques for changing decimals to fractions.</li> <li>7. Describe the English system of measuring length.</li> <li>8. Describe the English system of measuring weight.</li> <li>9. Describe the English system of measuring volume or capacity.</li> <li>10. Describe the relationships between various English system linear units of measurement, such as inches, feet, yards, and miles.</li> <li>11. Describe the relationships between various English system units of volume or capacity, such as cups, pints, quarts, and gallons.</li> <li>12. Describe and demonstrate problem-solving techniques for various English system measuring problems, using arithmetic operations.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C2.4, C2.7</p>



COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(8 hours)	<ol style="list-style-type: none"> <li>13. Describe and demonstrate measuring techniques of various objects by using the English system measuring tools common to the trade.</li> <li>14. Describe the metric system of measuring length.</li> <li>15. Describe the metric system of measuring weight.</li> <li>16. Describe the metric system of measuring volume or capacity.</li> <li>17. Describe the relationships between various metric system linear units of measurement, such as millimeters, centimeters, and meters.</li> <li>18. Describe the relationships between various metric system units of weight such as milligrams, grams, and kilograms.</li> <li>19. Describe and demonstrate problem-solving techniques for various metric system measuring problems involving addition, subtraction, multiplication, and division.</li> <li>20. Describe and demonstrate measuring techniques of objects using metric system measuring tools common to the trade.</li> <li>21. Describe and demonstrate problem-solving techniques for geometric problems that apply to auto repair and maintenance.</li> <li>22. Describe and demonstrate problem-solving techniques for algebraic problems that apply to auto repair and maintenance.</li> <li>23. Describe and demonstrate problem-solving techniques using percentages.</li> <li>24. Describe and demonstrate techniques for reading and interpreting graphs.</li> <li>25. Describe and demonstrate techniques for using a calculator.</li> </ol>	
<p>D. TOOLS AND EQUIPMENT</p> <p>Understand, apply, and evaluate the use, maintenance, and storage techniques for automotive tools and equipment.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify and demonstrate the proper use, maintenance, and storage techniques for the general shop hand tools.</li> <li>2. Identify and demonstrate the proper use, maintenance, and storage techniques for the general shop equipment.</li> <li>3. Identify and demonstrate the proper use, maintenance, and storage techniques for the following specialty tools and equipment for engine performance: <ol style="list-style-type: none"> <li>a. four or five gas exhaust analyzers (five gas recommended)</li> <li>b. fuel injection pressure gauge sets with adapters</li> <li>c. injector pulse tester</li> <li>d. leak detector (smoke or nitrogen)</li> <li>e. logic probe (suggested)</li> <li>f. oxygen sensor socket</li> <li>g. pinch-off pliers</li> <li>h. sending unit socket(s)</li> <li>i. spark plug thread tap</li> <li>j. spark tester</li> <li>k. timing advance light</li> <li>l. vacuum/pressure gauge</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 3, 5, 10</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.3, 6.6 Technical Knowledge and Skills: 10.1 Demonstration and Application 11.1</p> <p><b>CTE Pathway:</b> C2.2, C2.3</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>E. SERVICE MANUALS AND COMPUTER-BASED INFORMATION SYSTEMS REVIEW</p> <p>Review, apply, and evaluate the contents of service manuals and computer-based information systems as important sources of reference to an auto technician.</p> <p>(2 hours)</p>	<ol style="list-style-type: none"> <li>1. Review the different types of service manuals.</li> <li>2. Review the different types of information that can be found in service manuals such as specifications, troubleshooting charts, and repair information.</li> <li>3. Review and demonstrate the use of service manuals.</li> <li>4. Review and demonstrate the use of CD-ROM (compact disc) and web-based search engines in finding automotive technical information.</li> <li>5. Review the advantages of using CD-ROM and web-based search engines over service manuals in finding automotive technical information.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3 Technology: 4.1, 4.2, 4.6 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3 Ethics and Legal Responsibilities: 8.1 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> 2.6, 4.3</p>
<p>F. ENGINE DESIGNS</p> <p>Understand, apply, and evaluate the principles of engine design found in domestic cars.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify the major parts of an automobile engine.</li> <li>2. Describe the basic function of each of the major parts of an automobile engine.</li> <li>3. Explain the four-stroke cycle of an internal combustion engine.</li> <li>4. Describe the features and functions of the different types of cylinder configurations.</li> <li>5. Explain the advantages and disadvantages of various cylinder configurations.</li> <li>6. Describe the features and functions of the following types of valve arrangements: <ol style="list-style-type: none"> <li>a. overhead valve</li> <li>b. overhead cam</li> <li>c. double overhead cam</li> <li>d. multiple valve heads</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3 Problem Solving and Critical Thinking: 5.1 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C2.1, C2.6, C3.1, 4.3, C5.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>G. BASIC AUTOMOTIVE ELECTRICITY</p> <p>Understand the fundamentals of electricity as it is used in automobiles.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Define the following:               <ol style="list-style-type: none"> <li>a. electricity</li> <li>b. current</li> <li>c. conductor</li> <li>d. resistance</li> <li>e. inductance</li> <li>f. voltage</li> </ol> </li> <li>2. Describe and demonstrate Ohm’s Law problems.</li> <li>3. Identify devices used in measuring electricity.</li> <li>4. Compare the similarities and differences between alternating current (AC) and direct current (DC).</li> <li>5. Identify electrical circuits and their components.</li> <li>6. Describe magnetism.</li> <li>7. Describe how electricity can be generated.</li> <li>8. List electrical systems found in cars.</li> <li>9. Describe an automotive storage battery.</li> <li>10. Test an automotive storage battery.</li> <li>11. Describe the function of fuses.</li> <li>12. List various electrical accessories.</li> <li>13. Describe the function of various electrical accessories.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3 Problem Solving and Critical Thinking: 5.1 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C2.4, C2.7, C3.5, C4.3</p>
<p>H. GENERAL ENGINE DIAGNOSIS</p> <p>Understand, apply, and evaluate the diagnostic techniques for engines.</p>	<ol style="list-style-type: none"> <li>1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1</li> <li>2. Identify and interpret engine performance concern; determine necessary action. P-1</li> <li>3. Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins. P-1</li> <li>4. Locate and interpret vehicle and major component identification numbers. P-1</li> <li>5. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action. P-2</li> <li>6. Diagnose abnormal engine noise or vibration concerns; determine necessary action. P-3</li> <li>7. Diagnose abnormal exhaust color, odor, and sound; determine necessary action. P-2</li> <li>8. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action. P-1</li> <li>9. Perform cylinder power balance test; determine necessary action. P-2</li> <li>10. Perform cylinder cranking and running compression tests; determine necessary action. P-1</li> <li>11. Perform cylinder leakage test; determine necessary action. P-1</li> <li>12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action. P-1</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4 Technology: 4.1, 4.2, 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Responsibility and Flexibility: 7.4 Ethics and Legal Responsibilities: 8.1 Technical Knowledge and Skills: 10.1, 10.2, 10.3 Demonstration and Application: 11.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(45 hours)	<ol style="list-style-type: none"> <li>13. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action. P-3</li> <li>14. Verify engine operating temperature; determine necessary action. P-1</li> <li>15. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action. P-1</li> <li>16. Verify correct camshaft timing. P1</li> </ol>	<p><b>CTE Pathway:</b> C2.1, C2.2, C2.5, C2.7, C4.3, C4.4, C6.1, C6.2, C6.3, C6.4</p>
<p>I. COMPUTERIZED ENGINE CONTROLS DIAGNOSIS AND REPAIR</p> <p>Understand, apply, and evaluate the diagnostic and repair techniques for computerized engine controls.</p> <p>(45 hours)</p>	<ol style="list-style-type: none"> <li>1. Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data, clear codes when applicable. P-1</li> <li>2. Diagnose the causes of emissions or drivability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data. P-1</li> <li>3. Diagnose emissions or drivability concerns without stored diagnostic trouble codes; determine necessary action. P-1</li> <li>4. Check for module communication (including CAN/BUS systems) errors using a scan tool. P-2</li> <li>5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO); perform necessary action. P-1</li> <li>6. Access and use service information to perform step-by-step diagnosis. P-1</li> <li>7. Diagnose drivability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems); determine necessary action. P-3</li> <li>8. Perform active tests of actuators using a scan tool; determine necessary action. P-1</li> <li>9. Describe the importance of running all OBDII monitors for repair verification. P-1</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4 Technology: 4.1, 4.2, 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Responsibility and Flexibility: 7.4 Ethics and Legal Responsibilities: 8.1 Technical Knowledge and Skills: 10.1, 10.2, 10.3 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C2.1, C2.3, C2.4, C2.6, C3.5, C3.7, C4.3, C6.1, C6.3</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>J. IGNITION SYSTEM DIAGNOSIS AND REPAIR</p> <p>Understand, apply, and evaluate the diagnostic and repair techniques for the ignition system.</p> <p>(45 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify and describe the features and functions of the starting system.</li> <li>2. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor drivability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action. P-1</li> <li>3. Inspect and test ignition primary and secondary circuit wiring and solid-state components; test ignition coil(s); perform necessary action. P-1</li> <li>4. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action. P-1</li> <li>5. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram, as necessary. P-2</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4 Technology: 4.1, 4.2, 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Responsibility and Flexibility: 7.4 Ethics and Legal Responsibilities: 8.1 Technical Knowledge and Skills: 10.1, 10.2, 10.3 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> 2.6, C3.5, C3.7, C4.3, C6.1, C6.4</p>
<p>K. HYBRID VEHICLES</p> <p>Understand and evaluate the basics of hybrid vehicles.</p>	<ol style="list-style-type: none"> <li>1. Define hybrid electric vehicles (HEVs).</li> <li>2. Describe the relationship between the gasoline engine and the electric motor in an HEV.</li> <li>3. Differentiate between an HEV and a vehicle powered by a gasoline engine on the bases of: <ol style="list-style-type: none"> <li>a. engine size</li> <li>b. fuel economy</li> <li>c. emissions</li> </ol> </li> <li>4. Describe the following technologies typically used by hybrids: <ol style="list-style-type: none"> <li>a. regenerative braking</li> <li>b. electric motor drive/assist</li> <li>c. automatic start/shutoff</li> </ol> </li> <li>5. Describe the optimum driving environment for an HEV.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 7, 11, 12</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5., 5.3 Responsibility and Flexibility: 7.4 Ethics and Legal Responsibilities:</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(7 hours)		8.1, 8.2 Technical Knowledge and Skills: 10.1  <b>CTE Pathway:</b> C1.1, C1.3, C1.5, C3.1, C3.4
L. ALTERNATIVE FUEL VEHICLES  Understand and evaluate the basics of alternative fuel vehicles.	<ol style="list-style-type: none"> <li>1. Define the concept of alternative fuel vehicles.</li> <li>2. Describe the following examples of alternative fuel vehicles:               <ol style="list-style-type: none"> <li>a. electric</li> <li>b. flex fuel</li> <li>c. fuel cell</li> </ol> </li> <li>3. Differentiate between an alternative fuel vehicle and a vehicle powered by a gasoline engine on the bases of:               <ol style="list-style-type: none"> <li>a. engine size</li> <li>b. fuel economy</li> <li>c. emissions</li> </ol> </li> </ol>	<b>Career Ready Practice:</b> 1, 2, 4, 5, 7, 11, 12  <b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5., 5.3 Responsibility and Flexibility: 7.4 Ethics and Legal Responsibilities: 8.1, 8.2 Technical Knowledge and Skills: 10.1  <b>CTE Pathway:</b> C1.1, C1.3, C1.5, C3.1, C3.4, C3.6
M. EMPLOYABILITY SKILLS  Understand, apply, and evaluate the employability skills required in auto repair and maintenance.	<ol style="list-style-type: none"> <li>1. Summarize employer requirements for the following:               <ol style="list-style-type: none"> <li>a. punctuality</li> <li>b. attendance</li> <li>c. attitude toward work</li> <li>d. quality of work</li> <li>e. teamwork</li> <li>f. timeliness</li> <li>g. communication skills</li> <li>h. computer skills and software applications</li> </ol> </li> <li>2. Identify potential employers through traditional and internet</li> </ol>	<b>Career Ready Practice:</b> 1, 2, 3, 5, 10, 11  <b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4, 2.5 Career Planning and Management: 3.5, 3.9

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(4 hours)	<p>sources.</p> <ol style="list-style-type: none"> <li>3. Design sample résumés and cover letters.</li> <li>4. Describe the role of electronic social networking in job search.</li> <li>5. Describe the importance of filling out a job application legibly, with accurate and complete information.</li> <li>6. Complete sample job application forms correctly.</li> <li>7. Describe the importance of enthusiasm on a job.</li> <li>8. Describe the importance of appropriate appearance on a job.</li> <li>9. Describe the importance of the continuous upgrading of job skills.</li> <li>10. Describe customer service as a method of building permanent relationships between the organization and the customer.</li> <li>11. Describe and demonstrate appropriate interviewing techniques.</li> <li>12. Identify the informational materials and resources needed to be successful in an interview.</li> <li>13. Design sample follow-up letters.</li> <li>14. Describe and demonstrate appropriate follow-up procedures.</li> </ol>	<p>Problem Solving and Critical Thinking: 5.1</p> <p>Responsibility and Flexibility: 7.2, 7.3, 7.4, 7.7</p> <p>Ethics and Legal Responsibility: 8.4, 8.5</p> <p>Leadership and Teamwork: 9.3</p> <p><b>CTE Pathway:</b> C5.4, C5.5</p>

## ***SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES***

### **TEXTBOOKS**

Dorries, Elizabeth. Today's Technician: Auto Engine Repair and Rebuilding, 2<sup>nd</sup> Edition. Thomson Delmar Learning, 2006.

Duffy, James E. Modern Automotive Technology, 7<sup>th</sup> Edition. Goodheart-Willcox Publishing, 2009.

Giles, Tim. Automotive Engines: Diagnosis, Repair, Rebuilding. Cengage Learning, 2006.

Halderman, James D. and Chase D. Mitchell. Steering and Suspension. Prentice Hall Professional Technical Reference, 2003.

Pickerill, Ken. Today's Technician: Automotive Engine Performance: Classroom Manual and Shop Manual, 4<sup>th</sup> Edition. Delmar Thomson Learning, 2005.

Sformo, Larry, Todd Sformo and George Moore. Practical Problems in Mathematics for Automotive Technicians, 6<sup>th</sup> Edition. Delmar Thomson Learning, 2004.

Webster, Jay, Clifton E. Owen, and Jack Erjavec. Basic Automotive Service & Systems, 2<sup>nd</sup> Edition. Thomson Delmar Learning, 2000.



## **RESOURCES**

Employer Advisory Board members

Foundation Standards

<http://www.cde.ca.gov/ci/ct/sf/documents/transportation.pdf>

Automotive Retailing Today (ART) 8400 Westpark Dr., MS 2, McLean, VA 22102. Phone: (703) 556-8578.

Automotive Youth Educational Systems (AYES) 50 W. Big Beaver, Suite 145, Troy, MI 48084. Phone: (248) 526-1750. Fax: (248) 526-1751.

National Automobile Dealers Association (NADA) Public Relations Dept., 8400 Westpark Dr., McLean, VA 22102-3591. Phone: (703) 821-7000.

National Automotive Technicians Education Foundation (NATEF) 101 Blue Seal Dr. SE, Suite 101, Leesburg, VA 20175. Phone: (703) 669-6650. Fax: (703) 669-6125. [www.natef.org](http://www.natef.org)

National Institute for Automotive Service Excellence (ASE) 101 Blue Seal Dr. SE, Suite 101, Leesburg, VA 20175. Phone: (703) 669-6600.

SkillsUSA P.O. Box 3000, Leesburg, VA 20177-0300. Phone: (703) 777-8810. Fax: (703) 777-8999. [www.skillsusa.org](http://www.skillsusa.org)

[www.familycar.com](http://www.familycar.com)

[www.freeonlineautorepair.com/automotive\\_fuel\\_system.html](http://www.freeonlineautorepair.com/automotive_fuel_system.html)

[www.fueleconomy.gov](http://www.fueleconomy.gov)

## **COMPETENCY CHECKLIST**

## ***TEACHING STRATEGIES and EVALUATION***

### **METHODS AND PROCEDURES**

- A. Lecture and discussion
- B. Multimedia presentations
- C. Visual aids
- D. Projects
- E. Individualized instruction
- F. Shop work

### **EVALUATION**

SECTION A – Orientation and Safety – Pass the safety test with 100% accuracy.

SECTION B – Resource Management – Pass all assignments and exams on resource management with a minimum score of 80% or higher.

SECTION C – Trade Mathematics – Pass all assignments and exams on trade mathematics with a minimum score of 80% or higher.

SECTION D – Tools and Equipment – Pass all assignments and exams on tools and equipment with a minimum score of 80% or higher.

SECTION E – Service Manuals and Computer-Based Information Systems – Pass all assignments and exams on service manuals and computer-based information systems with a minimum score of 80% or higher.

SECTION F – Engine Designs – Pass all assignments and exams on engine designs with a minimum score of 80% or higher.

SECTION G – Basic Automotive Electricity – Pass all assignments and exams on basic automotive electricity with a minimum score of 80% or higher.

SECTION H – General Engine Diagnosis – Pass all assignments and exams on general engine diagnosis with a minimum score of 80% or higher.

SECTION I – Computerized Engine Controls Diagnosis and Repair – Pass all assignments and exams on computerized engine controls diagnosis and repair with a minimum score of 80% or higher.

SECTION J – Ignition System Diagnosis and Repair – Pass all assignments and exams on ignition system diagnosis and repair with a minimum score of 80% or higher.

SECTION K – Hybrid Vehicles – Pass all assignments and exams on hybrid vehicles with a minimum score of 80% or higher.

SECTION L – Alternative Fuel Vehicles – Pass all assignments and exams on alternative fuel vehicles with a minimum score of 80% or higher.

SECTION M –Employability Skills – Pass all assignments and exams on employability skills with a minimum score of 80% or higher.

**NATEF TASK PRIORITY ITEM TOTALS (by area)**

I. Engine Repair

P-1 = 26 95% = 25 tasks  
P-2 = 22 80% = 18 tasks  
P-3 = 9 50% = 5 tasks

II. Automatic Transmission and Transaxle

P-1 = 21 95% = 20 tasks  
P-2 = 17 80% = 14 tasks  
P-3 = 4 50% = 2 tasks

III. Manual Drive Train and Axles

P-1 = 24 95% = 23 tasks  
P-2 = 24 80% = 19 tasks  
P-3 = 17 50% = 9 tasks

IV. Suspension and Steering

P-1 = 25 95% = 24 tasks  
P-2 = 25 80% = 20 tasks  
P-3 = 11 50% = 6 tasks

V. Brakes

P-1 = 39 95% = 37 tasks  
P-2 = 10 80% = 8 tasks  
P-3 = 11 50% = 6 tasks

VI. Electrical/Electronic Systems

P-1 = 39 95% = 37 tasks  
P-2 = 13 80% = 10 tasks  
P-3 = 10 50% = 5 tasks

VII. Heating and Air Conditioning

P-1 = 26 95% = 25 tasks  
P-2 = 14 80% = 11 tasks  
P-3 = 7 50% = 4 tasks

VIII. Engine Performance

P-1 = 39 95% = 37 tasks  
P-2 = 12 80% = 10 tasks  
P-3 = 7 50% = 4 tasks

## DEFINITIONS OF TECHNICAL TERMS

ADJUST - to bring components to specified operational settings.

ALIGN - to restore the proper position of components.

ANALYZE - to assess the condition of a component or system.

ASSEMBLE (REASSEMBLE) - to fit together the components of a device or system.

BALANCE - to establish correct linear, rotational or weight relationship.

BLEED - to remove air from a closed system.

CAN – Controller Area Network. CAN is a network protocol (SAE J2284/ISO 15765-4) used to interconnect a network of electronic control modules

CHARGE - to bring to a specified state, e.g., battery or air conditioning system.

CHECK - to verify condition by performing an operational or comparative examination.

CLEAN - to rid component of foreign matter for the purpose of reconditioning, repairing, measuring, or reassembling.

DEGLAZE – to remove a smooth glossy surface.

DETERMINE - to establish the procedure to be used to perform the necessary repair.

DETERMINE NECESSARY ACTION – indicates that the diagnostic routine(s) is the primary emphasis of a task. The student is required to perform the diagnostic steps and communicate the diagnostic outcomes and corrective actions required addressing the concern or problem. The training program determines the communication method (worksheet, test, verbal communication, or other means deemed appropriate) and whether the corrective procedures for these tasks are actually performed.

DIAGNOSE - to identify the cause of a problem.

DISASSEMBLE - to separate a component's parts as a preparation for cleaning, inspection, or service.

DISCHARGE - to empty a storage device or system.

EVACUATE - to remove air, fluid, or vapor from a closed system by use of a vacuum pump.

FLUSH - to internally clean a component or system.

HIGH VOLTAGE – voltages of 50 volts and higher.

HONE - to restore or resize a bore by using rotating cutting stones.

JUMP START - to use an auxiliary power supply to assist a battery to crank an engine.

LOCATE – to determine or establish a specific spot or area.

MEASURE - to determine existing dimensions/values for comparison to specifications.

NETWORK - a system of interconnected electrical modules or devices.

ON-BOARD DIAGNOSTICS (OBD) - diagnostic protocol which monitors computer inputs and outputs for failures.

PARASITIC DRAW - electrical loads which are still present when the ignition circuit is OFF.

PERFORM - to accomplish a procedure in accordance with established methods and standards.

PERFORM NECESSARY ACTION – indicates that the student is to perform the diagnostic routine(s) and perform the corrective action item. Where various scenarios (conditions or situations) are presented in a single task, at least one of the scenarios must be accomplished.

PURGE - to remove air or fluid from a closed system.

REMOVE - to disconnect and separate a component from a system.

REPAIR - to restore a malfunctioning component or system to operating condition.

REPLACE - to exchange a component; to reinstall a component.

RESURFACE – to restore correct finish.

SERVICE - to perform a procedure as specified in the owner's or service manual.

TEST - to verify condition using meters, gauges, or instruments.

TORQUE - to tighten a fastener to specified degree or tightness (in a given order or pattern if multiple fasteners are involved on a single component).

VERIFY - to confirm that a problem exists after hearing the customer's concern; or, to confirm the effectiveness of a repair.

VOLTAGE DROP - a reduction in voltage (electrical pressure) caused by the resistance in a component or circuit.

## ***Standards for Career Ready Practice***

### **1. Apply appropriate technical skills and academic knowledge.**

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make connections between abstract concepts with real-world applications and recognize the value of academic preparation for solving problems, communicating with others, calculating measures, and performing other work-related practices.

### **2. Communicate clearly, effectively, and with reason.**

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, using written, verbal, electronic, and/or visual methods. They are skilled at interacting with others: they are active listeners who speak clearly and with purpose, and they are comfortable with terminology that is common to workplace environments. Career-ready individuals consider the audience for their communication and prepare accordingly to ensure the desired outcome.

### **3. Develop an education and career plan aligned with personal goals.**

Career-ready individuals take personal ownership of their educational and career goals and manage their individual plan to attain these goals. They recognize the value of each step in the educational and experiential process, and they understand that nearly all career paths require ongoing education and experience to adapt to practices, procedures, and expectations of an ever-changing work environment. They seek counselors, mentors, and other experts to assist in the planning and execution of education and career plans.

### **4. Apply technology to enhance productivity.**

Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They understand the inherent risks—personal and organizational—of technology applications, and they take actions to prevent or mitigate these risks.

### **5. Utilize critical thinking to make sense of problems and persevere in solving them**

Career-ready individuals recognize problems in the workplace, understand the nature of the problems, and devise effective plans to solve the problems. They thoughtfully investigate the root cause of a problem prior to introducing solutions. They carefully consider options to solve a problem and, once agreed upon, follow through to ensure the problem is resolved.

### **6. Practice personal health and understand financial literacy.**

Career-ready individuals understand the relationship between personal health and workplace performance. They contribute to their personal well-being through a healthy diet, regular exercise, and mental health activities. Career-ready individuals also understand that financial literacy leads to a secure future that enables career success.

### **7. Act as a responsible citizen in the workplace and the community.**

Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are aware of the impacts of their decisions on others and the environment around them, and they think about the short-term and long-term consequences of their actions. They are reliable and consistent in going beyond minimum expectations and in participating in activities that serve the greater good.

**8. Model integrity, ethical leadership, and effective management.**

Career-ready individuals consistently act in ways that align with personal and community-held ideals and principles. They employ ethical behaviors and actions that positively influence others. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they recognize the short-term and long-term effects that management's actions and attitudes can have on productivity, morale, and organizational culture.

**9. Work productively in teams while integrating cultural and global competence.**

Career-ready individuals contribute positively to every team, as both team leaders and team members. To avoid barriers to productive and positive interaction, they apply an awareness of cultural differences. They interact effectively and sensitively with all members of the team and find ways to increase the engagement and contribution of other members.

**10. Demonstrate creativity and innovation.**

Career-ready individuals recommend ideas that solve problems in new and different ways and contribute to the improvement of the organization. They consider unconventional ideas and suggestions by others as solutions to issues, tasks, or problems. They discern which ideas and suggestions may have the greatest value. They seek new methods, practices, and ideas from a variety of sources and apply those ideas to their own workplace practices.

**11. Employ valid and reliable research strategies.**

Career-ready individuals employ research practices to plan and carry out investigations, create solutions, and keep abreast of the most current findings related to workplace environments and practices. They use a reliable research process to search for new information and confirm the validity of sources when considering the use and adoption of external information or practices.

**12. Understand the environmental, societal, and economic impacts of decisions.**

Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact other people, organizations, the workplace, and the environment. They are aware of and utilize new technologies, understandings, procedures, and materials and adhere to regulations affecting the nature of their work. They are cognizant of impacts on the social condition, environment, workplace, and profitability of the organization.



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## Statement for Civil Rights

All educational and vocational opportunities are offered without regard to race, color, national origin, gender, or physical disability.

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