

# Course Outline

**Transportation**

**REVISED: August/2017**

**Job Title**  
Auto Technician

**79-90-71**

**Career Pathway:**  
Systems Diagnostics and Service

## **Auto Tech: Engine Performance/2**

**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. Emphasis is placed on the techniques in the following areas of engine performance: fuel, air induction, and exhaust systems, emission controls systems, and engine-related service. It also offers reviews of engine design, automotive electricity, hybrid vehicles, and alternative fuel vehicles. An introduction to entrepreneurship is also included as well as reviews of resource management, trade mathematics, tools and equipment, service manuals and computer-based information system, 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

**CBEDS No.:**  
5669

### **Prerequisites:**

Enrollment requires successful completion of the Auto Tech: Engine Performance/1 (79-90-69) course.

**NOTE:** For Perkins purposes this course has been designated as a **capstone** 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.weareadace.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. 7-14

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. 17-18

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 PAUL PIDOUX and MARCELA BAKER 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/2 Course**

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. INTRODUCTION AND SAFETY</p> <p>Review, 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. Review the scope and purpose of the course.</li> <li>2. Review classroom policies and procedures.</li> <li>3. Review classroom and workplace first aid and emergency procedures.</li> <li>4. Review the different occupations in the Transportation Industry Sector which have an impact on the role of the auto technician.</li> <li>5. Review the California Occupational Safety and Health Administration (Cal/OSHA) workplace requirements for auto technicians.</li> <li>6. Review the impact of Environmental Protection Agency (EPA) legislation on Transportation Industry Sector practices in protecting and preserving the environment.</li> <li>7. Review the impact of California Air Resources Board (ARB) legislation on Transportation Industry Sector practices in protecting and preserving the environment.</li> <li>8. Review the Bureau of Automotive Repair (BAR) standards for safety and environmental protection.</li> <li>9. Review and demonstrate the use of the Material Safety Data Sheet (MSDS) as it applies to the automotive industry.</li> <li>10. Review the safety items required by federal, state, and local regulations.</li> <li>11. Review the role of the National Automotive Technicians Education Foundation (NATEF) in auto technician training.</li> <li>12. Review and demonstrate the NATEF standards regarding proper use of protective clothing and gloves in an auto shop.</li> <li>13. Review and demonstrate the NATEF standards regarding proper use of protective respiratory gear in an auto shop.</li> <li>14. Review and demonstrate the NATEF standards regarding proper use of protective eye gear in an auto shop.</li> <li>15. Review and demonstrate the NATEF standards regarding proper ventilation in an auto shop.</li> <li>16. Review and demonstrate NATEF standards regarding proper handling, storage, and disposal of chemicals and materials used in an auto shop.</li> <li>17. Pass the safety exam with 100% accuracy.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 6, 7</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 REVIEW</b></p> <p>Review, apply, and evaluate the resource management principles and techniques in the auto repair and maintenance business.</p> <p>(1 hour)</p>	<ol style="list-style-type: none"> <li>1. Review the following:               <ol style="list-style-type: none"> <li>a. resources</li> <li>b. management</li> <li>c. sustainability</li> </ol> </li> <li>2. Review 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. Review 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. Review 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. Review the economic benefits and liabilities of managing resources in an environmentally responsible way.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 3, 5, 8</p> <p><b>CTE Anchor:</b> Responsibility and Flexibility: 7.1, 7.4, 7.6</p> <p><b>CTE Pathway:</b> C5.3</p>
<p><b>C. TRADE MATHEMATICS REVIEW</b></p> <p>Review, apply, and evaluate the mathematical requirements used in auto diagnosis, maintenance, and repair.</p>	<ol style="list-style-type: none"> <li>1. Review the practical applications of math in auto repair and maintenance.</li> <li>2. Review and demonstrate problem-solving techniques involving whole number problems, using addition, subtraction, multiplication, and division.</li> <li>3. Review and demonstrate problem-solving techniques involving various fraction problems, using arithmetic operations (addition, subtraction, multiplication, and division).</li> <li>4. Review and demonstrate problem-solving techniques involving various decimal problems, using arithmetic operations.</li> <li>5. Review and demonstrate techniques for changing fractions to decimals.</li> <li>6. Review and demonstrate techniques for changing decimals to fractions.</li> <li>7. Review the English system of measuring length.</li> <li>8. Review the English system of measuring weight.</li> <li>9. Review the English system of measuring volume or capacity.</li> <li>10. Review the relationships between various English system linear units of measurement, such as inches, feet, yards, and miles.</li> <li>11. Review the relationships between various English system units of volume or capacity, such as cups, pints, quarts, and gallons.</li> <li>12. Review and demonstrate problem-solving techniques for various English system measuring problems, using arithmetic operations.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 5</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.2</p> <p><b>CTE Pathway:</b> C2.4, C2.7</p>



COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(5 hour)	<ol style="list-style-type: none"> <li>13. Review and demonstrate measuring techniques of various objects by using the English system measuring tools common to the trade.</li> <li>14. Review the metric system of measuring length.</li> <li>15. Review the metric system of measuring weight.</li> <li>16. Review the metric system of measuring volume or capacity.</li> <li>17. Review the relationships between various metric system linear units of measurement, such as millimeters, centimeters, and meters.</li> <li>18. Review the relationships between various metric system units of weight such as milligrams, grams, and kilograms.</li> <li>19. Review and demonstrate problem-solving techniques for various metric system measuring problems involving addition, subtraction, multiplication, and division.</li> <li>20. Review and demonstrate measuring techniques of objects using metric system measuring tools common to the trade.</li> <li>21. Review and demonstrate problem-solving techniques for geometric problems that apply to auto repair and maintenance.</li> <li>22. Review and demonstrate problem-solving techniques for algebraic problems that apply to auto repair and maintenance.</li> <li>23. Review and demonstrate problem-solving techniques using percentages.</li> <li>24. Review and demonstrate techniques for reading and interpreting graphs.</li> <li>25. Review and demonstrate techniques for using a calculator.</li> </ol>	
<p>D. TOOLS AND EQUIPMENT REVIEW</p> <p>Review, apply, and evaluate the policies and procedures for using automotive diagnosis, maintenance, and repair tools and equipment in accordance with federal, state, and local safety and environmental regulations.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Review and demonstrate the proper use, maintenance, and storage techniques for the general shop hand tools.</li> <li>2. Review and demonstrate the proper use, maintenance, and storage techniques for the general shop equipment.</li> <li>3. Review 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 analyzer (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, 3</p> <p><b>CTE Anchor:</b> Health and Safety: 6.3</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>(1 hour)</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, 11</p> <p><b>CTE Anchor:</b> Communications: 2.3 Technology: 4.1, 4.2, 4.6</p> <p><b>CTE Pathway:</b> C2.6, C4.3</p>
<p>F. ENGINE DESIGN REVIEW</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, 5</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C2.1, C3.1, C5.1</p>
<p>G. AUTOMOTIVE ELECTRICITY REVIEW</p> <p>Review the fundamentals of electricity as it is used in automobiles.</p>	<ol style="list-style-type: none"> <li>1. Review the following definitions: <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. Solve Ohm's Law problems.</li> <li>3. Review the devices used in measuring electricity.</li> <li>4. Review the similarities and differences between alternating current (AC) and direct current (DC).</li> <li>5. Review electrical circuits and their components.</li> <li>6. Review magnetism.</li> <li>7. Review how electricity can be generated.</li> <li>8. Review the list of electrical systems found in cars.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 5, 11</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C3.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(3 hours)	9. Review the features and function an automotive storage battery. 10. Test an automotive storage battery. 11. Review the function of fuses. 12. Review the list of various electrical accessories. 13. Review the function of various electrical accessories.	
H. FUEL, AIR INDUCTION, AND EXHAUST SYSTEMS DIAGNOSIS AND REPAIR  Understand, apply, and evaluate the diagnostic and repair techniques for the fuel, air induction and exhaust systems according to the manufacturer's specifications.	1. Diagnose hot or cold no-starting, hard starting, poor drivability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action. P-1 2. Check fuel for contaminants and quality; determine necessary action. P-2 3. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action. P-1 4. Replace fuel filters. P-2 5. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air. P-2 6. Inspect and test fuel injectors. P-1 7. Verify idle control operation. P-1 8. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action. P-1 9. Perform exhaust system back-pressure test; determine necessary action. P-1 10. Test the operation of turbocharger/supercharger systems; determine necessary action. P-3	<b>Career Ready Practice:</b> 1, 3, 5, 10  <b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.2, 5.3, 5.4 Technical Knowledge and Skills: 10.3 Demonstration and Application: 11.1, 11.2  <b>CTE Pathway:</b> C3.7, C7.2, C7.3
I. EMISSION CONTROL SYSTEMS DIAGNOSIS AND REPAIR  Understand, apply, and evaluate the diagnostic and repair techniques for the emission systems according to the manufacturer's specifications.	1. Diagnose oil leaks, emissions, and drivability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action. P-2 2. Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action. P-2 3. Diagnose emissions and drivability concerns, caused by the exhaust gas recirculation (EGR) system; determine necessary action. P-1 4. Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters and hoses; perform necessary action. P-1 5. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action. P-2 6. Diagnose emissions and drivability concerns caused by the secondary air injection and catalytic converter systems; determine necessary action. P-2 7. Inspect and test mechanical components of secondary air injection systems; perform necessary action. P-3	<b>Career Ready Practice:</b> 1, 3, 5, 10  <b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.2, 5.3, 5.4 Technical Knowledge and Skills: 10.3 Demonstration and Application: 11.1, 11.2  <b>CTE Pathway:</b> C3.7, C6.2, C6.3, C7.7

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(45 hours)	<ol style="list-style-type: none"> <li>8. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action. P-3</li> <li>9. Inspect and test catalytic converter efficiency. P-1</li> <li>10. Diagnose emissions and drivability concerns caused by the evaporative emissions control system; determine necessary action. P-1</li> <li>11. Inspect and test components and hoses of the evaporative emissions control system; perform necessary action. P-1</li> <li>12. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action. P-1</li> </ol>	
<p>J. ENGINE-RELATED SERVICE</p> <p>Understand, apply, and evaluate the diagnostic, maintenance, and repair techniques for the engine-related components according to the manufacturer's specifications.</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. Adjust valves on engines with mechanical or hydraulic lifters. P-1</li> <li>3. Remove and replace timing belt; verify correct camshaft timing. P-1</li> <li>4. Remove and replace thermostat and gasket/seal. P-1</li> <li>5. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action. P-1</li> <li>6. Perform common fastener and thread repairs, to include: remove broken bolt, restore internal and external threads, and repair internal threads with a threaded insert. P-1</li> <li>7. Perform engine oil and filter change. P-1</li> <li>8. Identify hybrid vehicle internal combustion engine service precautions. P-3</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 5</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.2, 5.3, 5.4 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1, 11.2</p> <p><b>CTE Pathway:</b> C3.4, C3.7, C6.2, C6.4, C8.1</p>
<p>K. HYBRID VEHICLE REVIEW</p> <p>Review and evaluate the basics of hybrid vehicles.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Review the definition of hybrid electric vehicles (HEVs).</li> <li>2. Review the relationship between the gasoline engine and the electric motor in an HEV.</li> <li>3. Review the differences 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. Review 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. Review the optimum driving environment for an HEV.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 4, 5, 11</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C1.1, C1.3, C3.1, C3.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>L. ALTERNATIVE FUEL VEHICLES REVIEW</p> <p>Review and evaluate the basics of alternative fuel vehicles.</p> <p>(2 hours)</p>	<ol style="list-style-type: none"> <li>1. Review the definition of alternative fuel vehicles.</li> <li>2. Review 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. Review the differences 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>	<p><b>Career Ready Practice:</b> 1, 3, 4, 5, 11</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C1.1, C1.3, C3.1, C3.4</p>
<p>M. EMPLOYABILITY SKILLS REVIEW</p> <p>Review, apply, and evaluate the employability skills required in auto repair and maintenance.</p> <p>(3 hours)</p>	<ol style="list-style-type: none"> <li>1. Review 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. Update researched data on potential employers.</li> <li>3. Finalize sample résumés.</li> <li>4. Review the role of electronic social networking in job search.</li> <li>5. Review the importance of filling out a job application legibly, with accurate and complete information.</li> <li>6. Review sample job application forms for correct grammar, punctuation, and spelling.</li> <li>7. Review the importance of enthusiasm on a job.</li> <li>8. Review the importance of appropriate appearance on a job.</li> <li>9. Review the importance of the continuous upgrading of job skills.</li> <li>10. Review customer service as a method of building permanent relationships between the organization and the customer.</li> <li>11. Review and demonstrate appropriate interviewing techniques.</li> <li>12. Review the informational materials and resources needed to be successful in an interview.</li> <li>13. Review sample follow-up letters.</li> <li>14. Review and demonstrate appropriate follow-up procedures.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 3, 5, 10, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4 Career Planning and Management: 3.1, 3.2, 3.4, 3.8, 3.9 Technology: 4.3 Responsibility and Flexibility: 7.2, 7.4, 7.5, 7.7 Leadership and Teamwork: 9.2 Demonstration and Application: 11.5</p> <p><b>CTE Pathway:</b> C5.3, C5.4, C5.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>N. ENTREPRENEURIAL SKILLS</p> <p>Understand, apply, and evaluate the process involved in becoming an entrepreneur in the diesel repair and maintenance industry.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Define entrepreneurship.</li> <li>2. Identify the necessary characteristics of successful entrepreneurs.</li> <li>3. Describe the contributions of entrepreneurs to the auto repair and maintenance industry.</li> <li>4. Explain the purpose and components of a business plan.</li> <li>5. Examine personal goals prior to starting a business.</li> <li>6. Evaluate sources of monetary investment in a business opportunity.</li> <li>7. State various licensing requirements in the auto repair and maintenance business.</li> <li>8. Develop a scenario depicting the student as the auto repair and maintenance owner.</li> <li>9. Differentiate between sustainable and green business practices and standard business practices.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12</p> <p><b>CTE Anchor:</b> Communications: 2.3, 2.4 Career Planning and Management: 3.4, 3.5, 3.7, 3.9 Responsibility and Flexibility: 7.1, 7.6 Technical Knowledge and Skills: 10.3 Demonstration and Application: 11.3, 11.4, 11.5</p> <p><b>CTE Pathway:</b> C1.1, C5.3, 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 – Introduction and Safety – Pass the safety test with 100% accuracy.

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

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

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

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

SECTION F – Engine Design Review – Pass all assignments and exams on engine design review with a minimum score of 80% or higher.

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

SECTION H – Fuel, Air Induction, and Exhaust Systems Diagnosis – Pass all assignments and exams on fuel, air induction, and exhaust systems diagnosis with a minimum score of 80% or higher.

SECTION I – Emission Control Systems Diagnosis and Repair – Pass all assignments and exams on emission control systems diagnosis and repair with a minimum score of 80% or higher.

SECTION J – Engine-Related Service – Pass all assignments and exams on engine-related service with a minimum score of 80% or higher.

SECTION K – Hybrid Vehicle Review – Pass all assignments and exams on hybrid vehicle review with a minimum score of 80% or higher.

SECTION L – Alternative Fuel Vehicle Review – Pass all assignments and exams on alternative fuel vehicle review with a minimum score of 80% or higher.

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

SECTION N –Entrepreneurial Skills– Pass all assignments and exams on entrepreneurial 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 through the use of 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.

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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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