

# Course Outline

**Transportation**

**REVISED: August/2017**

**Job Title:**

Diesel Technician

**Career Pathway:**

Systems Diagnostics and Service

**Industry Sector:**

Transportation

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

49-3031.00

**CBEDS Title:**

Diesel Equipment Mechanics

**CBEDS No.:**

5657

**79-90-59**

## **Auto Tech: Drive Train (Diesel)**

**Credits:** 15

**Hours:** 180

**Course Description:**

This competency-based course is the last in a sequence of three 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 a medium/heavy truck specialty 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 as well as the effective use of service manuals and computer-based information systems. Emphasis is placed on the techniques in the following areas of diesel drive train diagnosis and repair: clutch, transmission, drive shaft, universal joint, and drive axle. It also teaches trade mathematics, resource management, and employability skills and entrepreneurial 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.

**Prerequisites:**

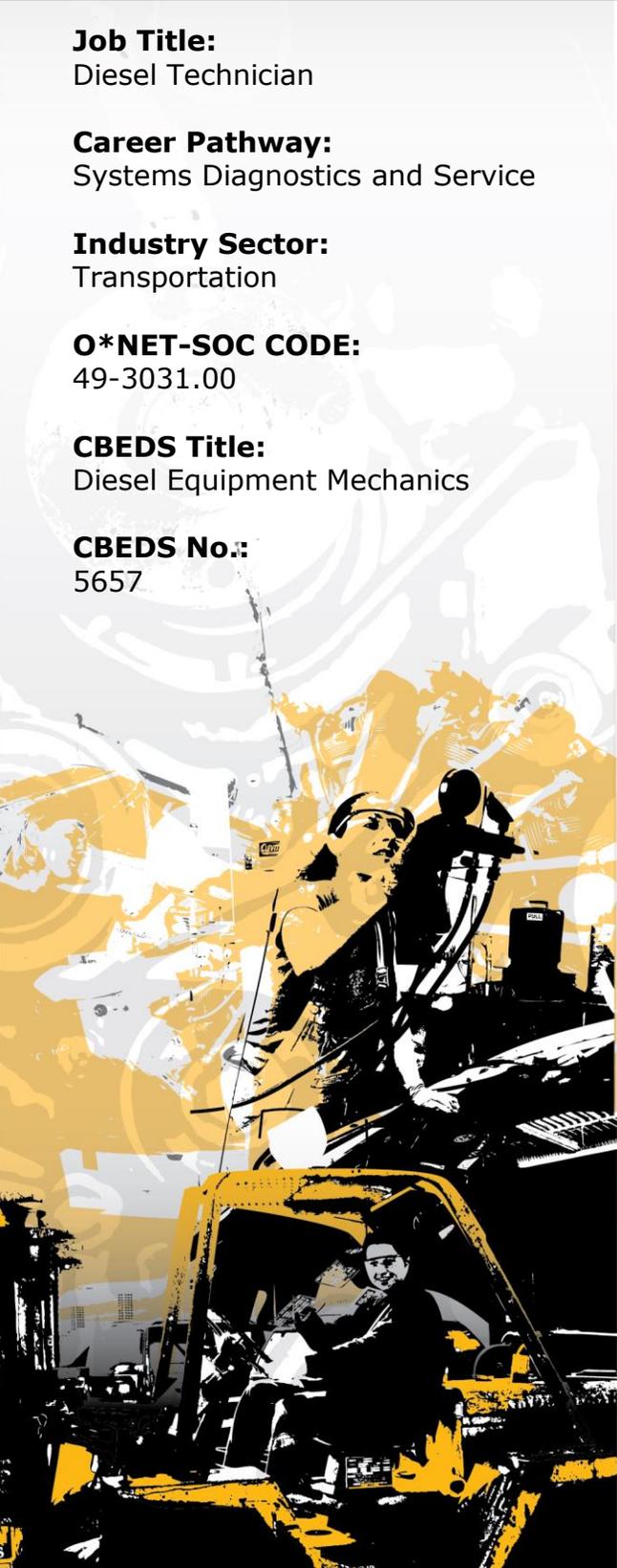
Enrollment requires successful completion of the Auto Tech: Diesel/2 (79-90-57) course.

**NOTE:** For Perkins purpose this course has been designated as a **capstone** course.

MEETS NATEF STANDARDS AND IDENTIFIES PRIORITY TASKS IN MEDIUM/HEAVY TRUCK DRIVE TRAIN. 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)**

<b>COURSE OUTLINE COMPONENTS</b>	<b>LOCATION</b>
<p><b>INSTRUCTIONAL STRATEGIES</b></p> <p>Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.</p> <p>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.</p>	p. 18
<p><b>UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT</b></p> <p>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.</p> <p>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.</p>	Cover  pp. 7-15
<p><b>EVALUATION PROCEDURES</b></p> <p>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.</p> <p>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.</p>	p. 18
<p><b>REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT</b></p> <p>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.</p>	Cover

## **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: Drive Train (Diesel) 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. Pass the safety exam with 100% accuracy.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 7, 12</p> <p><b>CTE Anchor:</b> Career Planning and Management: 3.4 Health and Safety: 6.1, 6.3, 6.6, 6.7 Ethics and Legal Responsibility: 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. RESOURCE MANAGEMENT</p> <p>Understand, 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. 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, 6</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>C. TRADE MATHEMATICS</p> <p>Understand, apply, and evaluate the mathematical requirements used in drive train technology.</p>	<ol style="list-style-type: none"> <li>1. Identify the practical applications of math in medium and heavy truck drive train 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> <li>13. Describe and demonstrate measuring techniques of various objects by using the English system measuring tools common to the trade.</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
(10 hours)	<ol style="list-style-type: none"> <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. SERVICE MANUALS AND COMPUTER-BASED INFORMATION SYSTEMS</p> <p>Understand, apply, and evaluate the contents of service manuals and computer-based information systems as important sources of reference to a drive train technician.</p> <p>(2 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe the different types of service manuals.</li> <li>2. Describe the different types of information that can be found in service manuals such as specifications, troubleshooting charts, and repair information.</li> <li>3. Describe and demonstrate the use of service manuals.</li> <li>4. Describe and demonstrate the use of CD-ROM (compact disc) and web-based search engines in finding auto technical information.</li> <li>5. Describe the advantages of using CD-ROM and web-based search engines over service manuals in finding auto 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>E. TOOLS AND EQUIPMENT</p> <p>Understand, apply, and evaluate the policies and procedures for using drive train tools and equipment in accordance with federal, state, and local safety and environment regulations.</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 medium and heavy truck drive trains: <ol style="list-style-type: none"> <li>a. 3/4" drive pinion nut sockets</li> <li>b. aligning studs - 3/8", 1/2", &amp; 5/8"</li> <li>c. axle shaft removal tool</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1, 4</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
(10 hours)	<ul style="list-style-type: none"> <li>d. blind hole/pilot bearing puller</li> <li>e. clutch adjusting tools (pull type)</li> <li>f. clutch disc aligning tool</li> <li>g. clutch jack and/or transmission jack attachments</li> <li>h. protractor (angle gauge)</li> <li>i. transmission jack</li> <li>j. U-joint puller</li> <li>k. yoke puller</li> </ul>	
<p>F. CLUTCH</p> <p>Understand and evaluate the diagnostic, maintenance, and repair techniques for clutches according to the manufacturer's specifications.</p> <p>(35 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify causes of clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action. P-1</li> <li>2. Inspect and adjust clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push and pull-type assemblies); check pedal height and travel; perform needed action. P-1</li> <li>3. Inspect, adjust, repair, or replace hydraulic clutch slave and master cylinders, lines, and hoses; bleed system. P-2</li> <li>4. Inspect, adjust, lubricate, or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals. P-1</li> <li>5. Inspect, adjust, and replace single-disc clutch pressure plate and clutch disc. P-1</li> <li>6. Inspect, adjust, and replace two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs. P-1</li> <li>7. Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer; perform needed action. P-1</li> <li>8. Inspect, adjust, and replace self-adjusting/continuous-adjusting clutch mechanisms. P-1</li> <li>9. Inspect and replace pilot bearing. P-2</li> <li>10. Inspect flywheel mounting area on crankshaft, rear main oil seal, and measure crankshaft end play; determine needed action. P-2</li> <li>11. Inspect flywheel, starter ring gear and measure flywheel face and pilot bore runout; determine needed action. P-2</li> <li>12. Inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action. P-2</li> <li>13. Inspect and test operation of automatic transmission electronic shift selectors, switches, displays and indicators, wiring harnesses. P-3</li> <li>14. Use appropriate diagnostic tools and procedures to diagnose automatic transmission problems; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed action. P-3</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.3, 2.4, 2.5 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: 10.3, 10.4 Demonstration and Application: 11.2</p> <p><b>CTE Pathway:</b> C2.1, C2.2, C2.3, C2.4, C2.5, C2.6, C3.3, C3.7, C4.4, C8.1, C8.2, C8.6</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>G. TRANSMISSION</p> <p>Understand, apply, and evaluate the diagnostic, maintenance, and repair techniques for transmissions according to the manufacturer’s specifications.</p> <p>(35 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify causes of transmission noise, shifting, lockup, jumping-out-of-gear, overheating, and vibration problems; determine needed action. P-1</li> <li>2. Inspect, test, repair, or replace air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies. P-2</li> <li>3. Inspect and replace transmission mounts, insulators, and mounting bolts. P-1</li> <li>4. Inspect for leakage and replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; repair as needed. P-1</li> <li>5. Check transmission fluid level and condition; determine needed service; add proper type of lubricant. P-1</li> <li>6. Inspect, adjust, and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires. P-2</li> <li>7. Remove and reinstall transmission. P-1</li> <li>8. Inspect input shaft, gear, spacers, bearings, retainers, and slingers; determine needed action. P-3</li> <li>9. Inspect transmission oil filters and coolers; replace as needed. P-2</li> <li>10. Inspect speedometer components; determine needed action. P-2</li> <li>11. Inspect and adjust power take-off (P.T.O.) assemblies, controls, and shafts; determine needed action. P-3</li> <li>12. Inspect and test function of reverse light, neutral start, and warning device circuits; determine needed action. P-1</li> <li>13. Inspect and test transmission temperature gauge and sensor/sending unit; determine needed action. P-2</li> <li>14. Inspect and test operation of automated mechanical transmission and manual electronic shift controls, shift, range and splitter solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses; determine needed action. P-2</li> <li>15. Inspect and test operation of automated mechanical transmission electronic shift selectors, air and electrical switches, displays and indicators, wiring harnesses, and air lines; determine needed action. P-2</li> <li>16. Use appropriate diagnostic tools and procedures to diagnose automated mechanical transmission problems; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed action. P-1</li> <li>17. Inspect and test operation of automatic transmission electronic shift controls, shift solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses. P-3</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5</p> <p><b>CTE Anchor:</b> Technology: 4.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Responsibility and Flexibility: 7.4 Ethics and Legal Responsibility: 8.1 Technical Knowledge and Skills: 10.3, 10.4 Demonstration and Application: 11.2</p> <p><b>CTE Pathway:</b> C2.1, C2.2, C2.3, C2.4, C2.5, C2.6, C3.3, C3.7, C4.1, C4.2, C4.3, C8.2, C8.6</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>H. DRIVESHAFT AND UNIVERSAL JOINTS</p> <p>Understand, apply, and evaluate the diagnostic, maintenance, and repair techniques for the driveshaft and universal joint according to the manufacturer's specifications.</p> <p>(25 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify causes of driveshaft and universal joint noise and vibration problems; determine needed action. P-1</li> <li>2. Inspect, service, or replace driveshaft, slip joints, yokes, drive flanges, and universal joints, driveshaft boots and seals, and retaining hardware; check phasing of all shafts. P-1</li> <li>3. Inspect driveshaft center support bearings and mounts; determine needed action. P-1</li> <li>4. Measure driveline angles; determine needed action. P-2</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.3, 2.4, 2.5 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 Responsibility: 8.1 Technical Knowledge and Skills: 10.3, 10.4 Demonstration and Application: 11.2</p> <p><b>CTE Pathway:</b> C2.1, C2.2, C2.3, C2.4, C2.5, C2.6, C3.3, C3.7, C4.4, C8.2</p>
<p>I. DRIVE AXLE</p> <p>Understand, apply, and evaluate the diagnostic, maintenance, and repair techniques for the drive axle according to the manufacturer's specifications.</p>	<ol style="list-style-type: none"> <li>1. Identify causes of drive axle(s) drive unit noise and overheating problems; determine needed action. P-2</li> <li>2. Check and repair fluid leaks; inspect and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals. P-1</li> <li>3. Check drive axle fluid level and condition; determine needed service; add proper type of lubricant. P-1</li> <li>4. Remove and replace differential carrier assembly. P-2</li> <li>5. Inspect and replace differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearings. P-3</li> <li>6. Inspect and replace components of locking differential case assembly. P-3</li> <li>7. Inspect differential carrier housing and caps, side bearing bores, and pilot (spigot, pocket) bearing bore; determine needed action. P-3</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5</p> <p><b>CTE Anchor:</b> Technology: 4.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Responsibility and Flexibility: 7.4, Ethics and Legal Responsibility: 8.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(35 hours)	<ol style="list-style-type: none"> <li>8. Measure ring gear runout; determine needed action. P-3</li> <li>9. Inspect and replace ring and drive pinion gears, spacers, sleeves, bearing cages, and bearings. P-3</li> <li>10. Measure and adjust drive pinion bearing preload. P-3</li> <li>11. Measure and adjust drive pinion depth. P-3</li> <li>12. Measure and adjust side bearing preload and ring gear backlash. P-3</li> <li>13. Check and interpret ring gear and pinion tooth contact pattern; determine needed action. P-3</li> <li>14. Inspect, adjust, or replace ring gear thrust block/screw. P-3</li> <li>15. Inspect power divider (inter-axle differential) assembly; determine needed action. P-3</li> <li>16. Inspect, adjust, repair, or replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls. P-2</li> <li>17. Inspect, repair, or replace drive axle lubrication system: pump, troughs, collectors, slingers, tubes, and filters. P-3</li> <li>18. Inspect and replace drive axle shafts. P-1</li> <li>19. Remove and replace wheel assembly; check rear wheel seal and axle flange gasket for leaks; perform needed action. P-1</li> <li>20. Identify causes of drive axle wheel bearing noise and check for damage; perform needed action. P-1</li> <li>21. Inspect and test drive axle temperature gauge and sending unit/sensor; determine needed action. P-2</li> <li>22. Clean, inspect, lubricate and replace wheel bearings; replace seals and wear rings; inspect and replace retaining hardware; adjust drive axle wheel bearings. P-1</li> </ol>	<p>Technical Knowledge and Skills: 10.3, 10.4</p> <p>Demonstration and Application: 11.2</p> <p><b>CTE Pathway:</b> C2.1, C2.2, C2.3, C2.4, C2.5, C2.6, C3.3, C3.7, C4.1, C4.2, C4.3, C7.7, C8.1, C8.2, C8.6</p>
<p>J. PREVENTATIVE MAINTENANCE</p> <p>Understand, apply, and evaluate the general diagnostic and repair techniques for auto engines according to the manufacturer's specifications</p>	<ol style="list-style-type: none"> <li>1. Explain the types of maintenance intervals for the various truck and heavy equipment.</li> <li>2. Check engine compartment for leaks (fuel, air, coolant, and exhaust).</li> <li>3. Inspect air intake system (mounts, hoses, clamps, restriction indicators, turbo) for leaks, damage, and restrictions.</li> <li>4. Listen and note unusual noises.</li> <li>5. Check optional equipment for proper operation.</li> <li>6. Check air conditioning condenser, radiator, and after-coolers for airflow restriction.</li> <li>7. Check for and repair fluid leaks; inspect and replace rear axle(s) drive unit cover plates, gaskets, vents, magnetic plugs, and seals.</li> <li>8. Remove and replace differential carrier assembly.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5</p> <p><b>CTE Anchor:</b> 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</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(15 hours)		Ethics and Legal Responsibility: 8.1 Demonstration and Application: 11.2  <b>CTE Pathway:</b> C2.1, C2.2, C2.3, C2.4, C2.5, C2.6, C3.1, C3.7, C4.1, C4.3, C6.1, C6.2, C6.3, C6.4, C7.1, C7.2, C7.3, C7.4, C7.5, C7.6, C7.7, C8.1, C8.2, C8.3, C8.4, C8.6
K. EMPLOYABILITY SKILLS  Understand, apply, and evaluate the employability skills required in auto repair and maintenance.	<ol style="list-style-type: none"> <li>1. Describe 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. responsibility</li> <li>g. timeliness</li> <li>h. communication skills</li> </ol> </li> <li>2. Identify potential employers through traditional and internet sources.</li> <li>3. Finalize sample résumés.</li> <li>4. Describe the importance of filling out a job application legibly, with accurate and complete information.</li> <li>5. Complete sample job application forms correctly.</li> <li>6. Describe the importance of enthusiasm on a job.</li> <li>7. Describe the importance of appropriate appearance on a job.</li> <li>8. Describe the importance of the continuous upgrading of job skills.</li> <li>9. Describe customer service as a method of building permanent relationships between the organization and the customer.</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 Career Planning and Management: 3.1, 3.2, 3.4, 3.9 Responsibility and Flexibility: 7.2, 7.4, 7.5, 7.7 Leadership and Teamwork: 9.2 Demonstration and Application: 11.5  <b>CTE Pathway:</b> C5.3, C5.4, C5.5
L. ENTREPRENEURIAL SKILLS  Understand, apply, and evaluate the process involved in becoming an entrepreneur in the repair and maintenance industry.	<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 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</li> </ol>	<b>Career Ready Practice:</b> 1, 2, 3, 5, 10, 11  <b>CTE Anchor:</b> Communications: 2.3, 2.4

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(3 hours)	<p>opportunity.</p> <ol style="list-style-type: none"> <li>7. Describe various licensing requirements in the auto repair and maintenance business.</li> <li>8. Develop a scenario depicting the student as the repair and maintenance business owner.</li> <li>9. Differentiate between sustainable and green business practices and standard business practices.</li> </ol>	<p>Career Planning and Management: 3.4, 3.5, 3.7, 3.9</p> <p>Responsibility and Flexibility: 7.1, 7.6</p> <p>Technical Knowledge and Skills: 10.3</p> <p>Demonstration and Application: 11.3, 11.4</p> <p><b>CTE Pathway:</b> C1.1, C5.3, C5.4, C5.5</p>

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

### **TEXTS AND SUPPLEMENTAL BOOKS**

Bell, Joseph. Modern Diesel Technology: Electricity and Electronics. Cengage Learning, 2006.

Bennett, Sean. Medium/Heavy Duty Truck Engines, Fuel and Computerized Management Systems. Cengage Learning, 2008.

Bosch, Robert GmbH. Diesel-Engine Management. Wiley, John and Sons, Incorporated, 2006.

Bosch, Robert GmbH. Electronic Diesel Control EDC. Bentley Publishers, 2001.

Dagel, John F., Robert N. Brady and John Dagel. Diesel Engine and Fuel System Repair. 5<sup>th</sup> Edition. (Hardcover). Prentice Hall, 2001.

Dempsey, Paul K. Troubleshooting and Repairing Diesel Engines. MacGraw-Hill Companies, 2007.

Dixon, John and Frank Dixon. Modern Diesel Technology: Heating, Ventilation, Air Conditioning and Refrigeration. Cengage Learning, 2006.

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

Norman, Andrew. Heavy Duty Truck Systems. 3<sup>rd</sup> Edition. Thomson Delmar Learning, 2000.

Norman, Andrew and John A. Corinchock. Diesel Technology: Fundamentals, Service, Repair. Goodheart-Willcox Publisher, November 2006.

Norman, Andrew, John A. Corinchock and Robert Scharff. Diesel Technology. Goodheart-Willcox Publisher, 2000.

Song, Chunshan. Chemistry of Diesel Fuel. CRC Press, 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)

[http://www.ed-foundation.org/html\\_pages/products\\_programs\\_services/natef\\_tools/non-structural\\_analysis/non-structural\\_analysis.shtml](http://www.ed-foundation.org/html_pages/products_programs_services/natef_tools/non-structural_analysis/non-structural_analysis.shtml)

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)

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

### **METHODS AND PROCEDURES**

- A. Lecture and discussion
- B. Demonstration
- C. Multi-sensory presentations
- D. Lab and live 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 – 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 E – Tools and Equipment – Pass all assignments and exams on tools and equipment with a minimum score of 80% or higher.

SECTION F – Clutch – Pass all assignments and exams on clutch with a minimum score of 80% or higher.

SECTION G – Transmission – Pass all assignments and exams on transmission with a minimum score of 80% or higher.

SECTION H – Driveshaft and Universal Joint– Pass all assignments and exams on driveshaft and universal joint with a minimum score of 80% or higher.

SECTION I – Drive Axle– Pass all assignments and exams on drive axle with a minimum score of 80% or higher.

SECTION J – Preventative Maintenance – Pass all assignments and exams on preventative maintenance with a minimum score of 80% or higher.

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

SECTION L – Entrepreneurial Skills – Pass all assignments and exams on entrepreneurial skills with a minimum score of 80% or higher.

## DEFINITIONS OF TECHNICAL TERMS

ADD - To increase fluid or pressure to the correct level or amount.

ADJUST - To bring components to specified operational settings.

AIR TEST - To use air pressure to determine proper action of components.

ALIGN - To bring to precise alignment or relative position of components.

ANALYZE - To examine the relationship of components of an operation.

ASSEMBLE (REASSEMBLE) - To fit together the components of a device.

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

BLEED – To remove air from a closed system.

CHARGE - To bring to "full" state; e.g., battery or air conditioning system.

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

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

DATA – Factual information, especially organized for analysis or used to reason or make decisions. Also, numerical or other information represented in a form suitable for processing by computer.

DEGLAZE – To restore correct surface finish.

DETERMINE - To establish the procedure to be used to effect 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 locate the root cause or nature of a problem by using the specified procedure.

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

DISCHARGE - To empty a storage device or system; e.g. static electricity release, battery, or air conditioning system.

DRAIN - To use gravity to empty a container.

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

FILL (REFILL) - To bring fluid level to specified point or volume.

FIND - To locate a particular problem, e.g. shorts, grounds or opens in an electrical circuit.

FLUSH - To use a fluid to clean an internal system.

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

IDENTIFY - To establish the identity of a vehicle or component prior to service; to determine the nature or degree of a problem.

INDICATE – To show as by measuring or recording such as a thermometer. Also, to point out or direct attention to a condition.

INSPECT - (SEE CHECK)

INSTALL (REINSTALL) - To place a component in its proper position in a system.

INTERFACE – To establish a communications link between an electronic control module and a diagnostic tool or computer.

ISOLATE – A technique where a component or system may be separated from the rest of the component or system.

JUMP START - To use an auxiliary power supply, i.e. battery, battery charger, etc. to assist a vehicle's battery to crank an engine.

LEAK TEST - To locate the source of leaks in a component or system.

LISTEN - To use audible clues in the diagnostic process; to hear the customer's description of a particular problem.

LOAD TEST – The process of creating demand on a system or device and measuring its response.

LUBRICATE - To employ the correct procedures and materials in performing the prescribed lubrication service.

MEASURE - To compare existing dimensions to specified dimensions by the use of calibrated instruments and gauges.

MOUNT - To attach or place tool or component in proper position.

OBSERVE – To watch, view, or note for a specific purpose.

PERFORM - To accomplish a procedure presented in a single task, at least one of the scenarios must be accomplished.

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.

PRESSURE TEST - To use air or fluid pressure to determine the condition or operation of a component or system.

PRIORITY RATINGS – Indicates the minimum percentage of tasks, by area, a program must include in its curriculum in order to be certified in that area.

PURGE - To eliminate an undesired air or fluid from a closed system.

READY - To prepare a system or component for service, installation or operation.

REASSEMBLE - (SEE ASSEMBLE)

RECOVER - To remove a substance, in any condition, from a system and store it in an external container.

REFILL - (SEE FILL)

REINSTALL - (SEE INSTALL)

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

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

REPLACE - To exchange an unserviceable component with a new or rebuilt component; to reinstall a component.

RESET (SET) - To adjust a variable component to a given, usually initial, specification.

SCAN – To read (data) for use by a computer or computerized device.

SELECT - To choose the correct part or setting during assembly or adjustment.

SERVICE - To perform a specified procedure when called for in the owner's or service manual.

TEST - To verify condition through the use of meters, gauges or instruments.

TIME – To adjust the timed relationship between the injection and/or ignition cycle(s) and engine cycle; or to set the operating relationship between two or more components or systems.

TRIM - (SEE ADJUST)

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).

VACUUM TEST - To determine the integrity and operation of a vacuum (negative pressure) operated component and/or system.

VERIFY - To establish that a problem exists after hearing the customer's complaint and performing a preliminary diagnosis; or to confirm that completed repairs address the customer complaint or problem.

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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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