

2005 Mississippi Curriculum Framework

Secondary Vehicle and Mobile Equipment Technician

(Program CIP: 47.0699 – Vehicle Maintenance and Repair Technology, Other)

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**Automotive Service Excellence/
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 Foundation** Reprinted with permission from ASE/NATEF Standards -
 2004 Medium/Heavy Truck Certifications (Brakes,
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 Seal Drive, Suite 101 Leesburg, VA 20175,

www.natef.org

Academic Standards Mississippi Department of Education Subject Area Testing Program

**Workplace Skills for the 21st
 Century** Secretary's Commission on Achieving Necessary Skills

**National Educational
Technology Standards for
Students**

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Foreword

Secondary vocational-technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act III, 1998; and No Child Left Behind Act of 2001).

Each secondary vocational-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80 percent of the time in the course.
- Competencies and Suggested Objectives
 - A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies.
 - The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies which reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.
- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.

- Integrated Academic Topics, Workplace Skills, Technology Standards, and Occupational Standards - This section identifies related academic topics as required in the Subject Area Assessment Program (SATP) in Algebra I, Biology I, English II, and U. S. History from 1877, which are integrated into the content of the unit. It also identifies the general workplace skills as identified in the Secretary's Commission on Achieving Necessary Skills (SCANS) report as being critical for all workers in the 21st Century. In addition, national technology standards and occupational skills standards associated with the competencies and suggested objectives for the unit are also identified.
- References - A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

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Program Description

Vehicle and Mobile Equipment Technician is a two-year instructional program that provides students with a foundation of skills and knowledge related to the service and repair of vehicles and power equipment. Students who complete the program may enter employment in an entry level position or continue their education in a postsecondary technical program such as automotive technology, diesel equipment technology, and other related areas. Students receive instruction in the maintenance and service of a variety of vehicles including small equipment, automobiles, trucks, and tractors/construction equipment. The program consists of two courses, each nine months in length. Each course must be taught in a minimum two-class block. The first course in the program includes instruction in the foundation skills related to safety, tool and equipment usage, measurement, brakes/basic hydraulics, electrical service and electronic controls. The second course in the program provides students with foundation skills related to gasoline and diesel engine systems and theory, steering and suspension systems.

The program is aligned with ASE/NATEF–2004 Medium/Heavy Truck standards. The student will receive instruction and training in: Brakes, Electrical/Electronics, Diesel, and Steering and Suspension.

Course Outline

Vehicle and Mobile Equipment Technician I

Course CIP Code: 47.0601

Unit	Title	Hours
Unit 1:	Introduction and Orientation	3.0-10.0
Unit 2:	Safety	5.0-15.0
Unit 3:	Tools, Technical References, Measurement, and Fasteners	5.0-15.0
Unit 4:	Brakes/Basic Hydraulics	87.0-105.0
Unit 5:	Basic Electrical Service and Electronic Controls	170.0-200.0

Vehicle and Mobile Equipment Technician II

Course CIP Code: 47.0615

Unit	Title	Hours
Unit 1:	Introduction, Orientation, Employability Skills, and Safety	3.0-10.0
Unit 2:	Advanced Tools, Technical References, Measurement, and Fasteners	5.0-15.0
Unit 3:	Advanced Electrical Services and Electronic Systems	20.0-25.0
Unit 4:	Diesel Systems and Theory	169.0-205.0
Unit 5:	Steering and Suspension Systems	73.0-90.0

The range of hours gives instructors the flexibility to meet local scheduling requirements.

Programs should choose the maximum hours allowed by their schedule.

Minimum hours may be applied to Vehicle and Mobile Equipment Technician I: Units 1, 2, 3 and Vehicle and Mobile Equipment Technician II: Unit 1 and 2.

Emphasis should be placed to Vehicle and Mobile Equipment Technician I: Units 4 and 5 and Vehicle and Mobile Equipment Technician II: Units 3, 4, and 5.

**Vehicle and Mobile Equipment Technician I
Unit 1: Introduction and Orientation**

(3-10 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Describe local program and vocational/career technical center policies and procedures.</p> <p>a. Describe local program and vocational/career technical center policies and procedures including dress code, attendance, academic requirements, discipline, and transportation regulations.</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • Present local program and vocational/career technical center policies and procedures.^{E2} • Students will read the handbook to become aware of what is expected of them in relation to the policies and procedures of the school. This will include dress code, attendance, academic requirements, discipline, and transportation regulations. Students will work together in pairs. A student with a higher reading ability will team up with a student with a lower reading ability to get a better understanding of the school's program policies and procedures. Submit written report on rules and regulations.^{E2, E3, E8} <p>Assessment:</p> <ul style="list-style-type: none"> • Assess student orientation, policy, and procedure knowledge through instructor observations and written unit test. File completed test to document student mastery of the school and program policies and procedures. • The report will be evaluated for clarity and content.
<p>2. Describe employment opportunities and responsibilities.</p> <p>a. Describe employment opportunities including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements.</p> <p>b. Describe basic employee responsibilities.</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • Define trade terms related to basic employability skills. • Students will interview individuals in the automotive industry. Students will be provided questions by the instructor. The student will write a report on the interview and present the report to the class.^{E1, E2} • Students will research the phone book, Internet, and newspapers for employment opportunities.^{E3, E8} • Students will participate in a mock interview. Industry representatives will interview students. • Invite a guest speaker to speak on industry

	<p>related information.</p> <ul style="list-style-type: none"> • Students will use career software, such as Choices, to measure their aptitudes and abilities for particular careers. ^{E3, E8} • Students will use available resources (college catalogs and websites) to research information about postsecondary educational opportunities. ^{E2, E3, E4, E5, E10} • Students will select a career in the field and outline educational and skill requirements, expected job growth, and entry-level salaries. ^{E1, E3, E8, E9} <p>Assessment:</p> <ul style="list-style-type: none"> • Assessment will be determined by matching test for definitions. Lessons involving writing and math skill will be integrated with the appropriate department. • A checklist will be used to evaluate each student. • The presentation and report on the automotive industry interview will be evaluated using a rubric. • Use a checklist to evaluate the presentation. • Review career software printout to assess student aptitudes and abilities.
<p>3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA.</p> <ol style="list-style-type: none"> a. Demonstrate effective teambuilding and leadership skills. b. Practice appropriate work ethics. 	<p>Teaching:</p> <ul style="list-style-type: none"> • Discuss the role of a team member and leader. Assign the students roles within a team and have them role play a situation in which there is a conflict which must be resolved. Utilize the lessons from SkillsUSA or other resources to provide additional training. ^{E3, E8} • Discuss appropriate work ethics standards. Have the students list what they believe to be the most common problems within the automotive profession. <p>Assessment:</p> <ul style="list-style-type: none"> • Assess the role play using a checklist for documentation. • Lessons from other resources should be assessed according to the recommended resource guide. • The list of work ethic practices will be

<p>4. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on- the-job situations.</p>	<p>graded for clarity and content.</p> <p>Teaching:</p> <ul style="list-style-type: none"> • Have the students perform an activity involving verbal instructions. Divide the students into groups and have one team be the customer and the other be the service advisor. The customer will describe the concern, and the service advisor will provide an explanation of the processes that will need to be followed for them to properly diagnose the concern. Have the groups switch roles and repeat the process. E2, E3, E4, E8 • The student will be given a work order. The work order will contain written instructions of a specific job. The student will complete the work order. <p>Assessment:</p> <ul style="list-style-type: none"> • The lesson will be assessed using a presentation rubric. • The work order will be evaluated using a checklist.
<p>5. Discuss the history of the automotive industry to include materials, terminology, and techniques.</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • Discuss the history of the automotive industry. Have the students research the history of the automotive industry and develop a presentation for the class.^{H1, H2} <p>Assessment:</p> <ul style="list-style-type: none"> • Assess the presentation using a presentation checklist.

STANDARDS

2004 ASE/NATEF Medium/Heavy Truck Technician Standards

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper

- ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Academic Standards

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- E10 Use language and critical thinking strategies to serve as tools for learning.
- H1 Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

Suggested References

- Automotive technology: The electronic classroom—Basic automotive.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Brakes.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Electrical/electronics.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
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Vehicle and Mobile Equipment Technician I
Unit 2: Safety

(5-15 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Describe general safety rules for working in a shop/lab and industry.</p> <ol style="list-style-type: none"> Describe how to avoid on-site accidents. Explain the relationship between housekeeping and safety. Explain the importance of following all safety rules and company safety policies. Explain the importance of reporting all on-the-job injuries and accidents. Explain the need for evacuation policies and the importance of following them. Explain the employer’s substances abuse policy and how it relates to safety. Explain the safety procedures when working near pressurized or high temperature. 	<p>Teaching: This can be used for the entire unit.</p> <ul style="list-style-type: none"> Identify, discuss, and demonstrate terms, rules, and procedures related to shop/lab and industry safety.^{E3, E8} Required written tests will follow each section of guidelines for safety rules and procedures. Provide the students with a list of terms and have them define the terms. Pair the students to quiz each other on the definitions in preparation for a written exam.^{E2, E3, E4, E8} Use the guidelines provided for personal safety (i.e., clothing, jewelry, hair, eyes, and ears). Divide the students into pairs and assign each pair one of the guidelines. Each pair will demonstrate the “do’s and don’ts” of the guideline. Have an industry speaker present to the class the necessity of safety in the work environment. The students will write a summary of the presentation.^{E1, E2, E9} Divide the students into teams and have them develop scenarios of hazards and accidents using the publications and the Internet. This will include tools, spills, working around welding, ladders or scaffolds, use of MSDS information, fires, and electrical situations. In a game type situation, one team will read a scenario and the other teams will compete to be the first to provide the proper safety measures which should have been used to prevent the hazardous situation. Points will be awarded to the teams with the correct answers.^{E2, E4} Required written tests will follow each section of guidelines for safety rules and procedures. NOTE: SAFETY IS TO BE TAUGHT AS AN ONGOING PART OF THE COURSE THROUGHOUT THE YEAR.
<p>2. Identify and apply safety around automotive operations.</p> <ol style="list-style-type: none"> Use proper safety practices when performing automotive operations. Recognize and explain personal protective equipment. Inspect and care for personal protective equipment. 	
<p>3. Explain lifting.</p> <ol style="list-style-type: none"> Identify and explain the procedures for lifting heavy objects. 	
<p>4. Explain the Material Safety Data Sheet (MSDS).</p> <ol style="list-style-type: none"> Explain the function of the MSDS. Interpret the requirements of the MSDS. 	
<p>5. Explain fires.</p> <ol style="list-style-type: none"> Explain the process by which fires start. Explain fire prevention of various flammable liquids. 	

<p>c. Explain the classes of fire and the types of extinguishers.</p>	<p>Assessment:</p> <ul style="list-style-type: none"> • Student participation will be monitored by the instructor and the written exam will be graded. The student must achieve 100% accuracy. • The “do’s and don’ts” exercise will be critiqued with a peer review. • The summary of the speaker’s presentation will be critiqued using a rubric. • The teams will be rewarded according the points earned from the game. This could be extra points, classroom privileges, etc. • Written exams will be graded.
<p>6. Explain safety in and around automotive and electrical situations.</p> <p>a. Explain injuries when electrical contact occurs.</p> <p>b. Explain safety around automotive and electrical hazards.</p> <p>c. Explain action to take when an electrical shock occurs.</p>	

STANDARDS

2004 ASE/NATEF Medium/Heavy Truck Technician Standards

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTB2 Air Brakes Diagnosis and Repair.
- MTB3 Hydraulic Brakes System Diagnosis and Repair.
- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTE8 Related Electrical Systems.
- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS2 Steering Systems Diagnosis and Repair.
- MTS3 Suspension Systems Diagnosis and Repair.
- MTS4 Wheel Alignment Diagnosis, Adjustment, and Repair.

- MTS5 Wheel and Tire Diagnosis and Repair.
- MTS6 Frame Service and Repair.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced:
Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD2 General Engine Diagnosis.
- MTD3 Cylinder Head and Valve Train Diagnosis and Repair.
- MTD4 Engine Block Diagnosis and Repair.
- MTD5 Lubrication Systems Diagnosis and Repair.
- MTD6 Cooling System Diagnosis and Repair.
- MTD7 Air Induction, and Exhaust Systems Diagnosis and Repair.
- MTD8 Fuel System Diagnosis and Repair.
- MTD9 Engine Brakes.

Academic Standards

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.

WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

Suggested References

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Vehicle and Mobile Equipment Technician I

Unit 3: Tools, Technical References, Measurement, and Fasteners

(5-15 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Demonstrate safe and proper use and storage of tools and equipment in an automotive shop.</p> <ol style="list-style-type: none"> a. Identify and demonstrate the safe and proper use of common hand tools including welders (ARC/MIG) and Oxy/Fuel cutting unit, wrenches, sockets, pliers, screwdrivers, striking tools, etc. b. Identify and demonstrate the safe and proper use of lifting and hoisting equipment. c. Identify and demonstrate the safe and proper use of cleaning equipment. d. Identify and demonstrate the safe and proper use of power equipment including impact wrenches, drills, grinders, and presses. e. Organize and maintain a systematic storage system for hand and power tools. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will review automotive supply catalogs and self-made pictures of tools and equipment that students will use in the program.^{E8} • The instructor will discuss and demonstrate safety procedures, proper use, and storage of tools and equipment. The student will demonstrate safety procedures, proper use, and storage of tools and equipment. A specific task will be assigned to a group of students. The group will make a list of the proper tools that will be required to complete the task and present their decisions to the class.^{E2, E4, E5} • The instructor will explain and demonstrate the use of software for the specific area of instruction. The student will use the software for tool identification.^{E3} <p>Assessment:</p> <ul style="list-style-type: none"> • A tool identification test. • A job sheet will be evaluated for the task and a rubric for the presentation. • The results from the software test will be printed and evaluated.
<p>2. Locate and apply service specifications and information.</p> <ol style="list-style-type: none"> a. Locate service specifications and information, using both print and computerized service information references. b. Interpret and apply information to a specific job on a specific vehicle. c. Locate and interpret vehicle and major component identification numbers (VIN, certification, and calibration labels). 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will review the text, Internet, manuals, and handouts for locating and applying information. The student will be assigned to locate specific information using text, Internet, manuals, and handouts for locating and information for an assigned task.^{E3, E8} <p>Assessment:</p> <ul style="list-style-type: none"> • The information will be recorded on the job sheet.

<p>3. Demonstrate measurement practices used in the automotive service.</p> <ol style="list-style-type: none"> a. Measure the length of an object using a rule to the nearest 1/16th of an inch and 1 millimeter. b. Measure the inside diameter, outside diameter, and/or depth to the nearest .001 of an inch and nearest .1 millimeter, using precision measuring instruments (micrometers, calipers, and dial indicators). 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will give a worksheet on measurement. • The instructor will demonstrate how to measure a given item using a variety of measuring instruments. The student will measure given items and record the answers.^{E3,E8} • The instructor will explain and demonstrate software to review measuring skills. The student will use software to complete worksheets. <p>Assessment:</p> <ul style="list-style-type: none"> • A worksheet will be evaluated. • The student will measure given items and record on a job sheet for evaluation. • The worksheets will be evaluated.
<p>4. Identify common fasteners and describe their use.</p> <ol style="list-style-type: none"> a. Identify the different types of bolts, nuts, and washers; and describe their appropriate uses. b. Identify bolts by grade, diameter, length, and thread pitch. c. Identify different glues and sealants used in automotive service, and describe their appropriate use. d. Restore internal and external threads. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and show fasteners using catalogs. The instructor will display several models that the students can view and manipulate. The students will analyze the fasteners, apply the proper fasteners, and present the decisions to the class.^{E3} <p>Assessment:</p> <ul style="list-style-type: none"> • A rubric will be used for evaluation.

STANDARDS

2004 ASE/NATEF Medium/Heavy Truck Technician Standards

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTB2 Air Brakes Diagnosis and Repair.
- MTB3 Hydraulic Brakes System Diagnosis and Repair.
- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTE8 Related Electrical Systems.
- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS2 Steering Systems Diagnosis and Repair.
- MTS3 Suspension Systems Diagnosis and Repair.
- MTS4 Wheel Alignment Diagnosis, Adjustment, and Repair.
- MTS5 Wheel and Tire Diagnosis and Repair.
- MTS6 Frame Service and Repair.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD2 General Engine Diagnosis.
- MTD3 Cylinder Head and Valve Train Diagnosis and Repair.
- MTD4 Engine Block Diagnosis and Repair.
- MTD5 Lubrication Systems Diagnosis and Repair.
- MTD6 Cooling System Diagnosis and Repair.
- MTD7 Air Induction, and Exhaust Systems Diagnosis and Repair.
- MTD8 Fuel System Diagnosis and Repair.
- MTD9 Engine Brakes.

Academic Standards

- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

Suggested References

- Automotive technology: The electronic classroom—Basic automotive.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Brakes.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Electrical/electronics.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Steering and suspension.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
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- Automotive technology curriculum—Brakes.* (2003). Columbia, MO: Instructional Materials Laboratory. (Instructor guide, student guide, workbook, CD-ROM, student task list, and transparencies available)

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Barbieri, D., Kellum, M., & Miller, R. (1998). *Diesel technology: Engines.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.

Eichhorn, L., & Joerschke, J. (2001). *Diesel technology: Introduction.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.

Hilley, R., Kellum, M., & Scarberry, T. (2000). *Diesel technology: Brakes.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.

Vehicle and Mobile Equipment Mechanics I
Unit 4: Brakes/Basic Hydraulics

(87-105 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Explore air brake diagnosis and repair.</p> <ul style="list-style-type: none"> a. Identify and interpret an air brake system concerns; determine necessary action. b. Research applicable service information; locate and interpret identification numbers, certification, and calibration decals. 	<p>Teaching:</p> <p>Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.</p> <ul style="list-style-type: none"> • The instructor will present a video on the given task. The student will develop several questions and answers from the video. ^{E1} • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concerns. ^{E1, E2, E3, E5, E8, E9, E10} • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task. ^{E3, E4, E5} • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. <p>Assessment:</p> <ul style="list-style-type: none"> • The questions and answers will be evaluated for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks.
<p>2. Explore air supply and service systems.</p> <ul style="list-style-type: none"> a. Evaluate customer concerns of poor stopping, air leaks, premature wear, pulling, grabbing, or dragging problems caused by supply, and service system malfunctions; determine needed action. b. Check air system build-up time; determine needed action. c. Drain air reservoir tanks; check for oil, water, and foreign material; determine needed action. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ○ Evaluate customer concerns of poor stopping, air leaks, premature wear, pulling, grabbing, or dragging problems caused by supply, and service system malfunctions; determine needed action. ○ Check air system build-up time; determine needed action. ○ Drain air reservoir tanks; check for oil,

<ul style="list-style-type: none"> d. Inspect, adjust, and align compressor drive belts, pulleys, and tensioners; replace as needed. e. Inspect and test system pressure controls: governor, unloader assembly valves, intake screens, filters, lines, hoses, and fittings; replace as needed. f. Inspect air compressor, air cleaner/supply; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed. g. Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed. h. Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check-valves, and manual and automatic drain valves; replace as needed. i. Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed. j. Inspect and test: <ul style="list-style-type: none"> o Brake application (foot) valve, fittings, and mounts; adjust or replace as needed. o Stop light circuit switches, wiring, and connectors; repair or replace as needed. o Hand brake (trailer) control valve, lines, fittings, and mountings; repair or replace as needed. o Brake relay valve; replace as needed. o Quick release valves; replace as needed. o Tractor protection valve; replace as needed. o Emergency (spring) brake control/modulator valve(s); replace as needed. o Low pressure warning devices, wiring, and connectors; replace as needed. o Air pressure gauges, lines, and 	<p>water, and foreign material; determine needed action.</p> <ul style="list-style-type: none"> o Inspect, adjust, and align compressor drive belts, pulleys, and tensioners; replace as needed. o Inspect and test system pressure controls: governor, unloader assembly valves, intake screens, filters, lines, hoses, and fittings; replace as needed. o Inspect air compressor, air cleaner/supply; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed. o Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed. o Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check-valves, and manual and automatic drain valves; replace as needed. o Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed. o Inspect and test: <ul style="list-style-type: none"> • Brake application (foot) valve, fittings, and mounts; adjust or replace as needed. • Stop light circuit switches, wiring, and connectors; repair or replace as needed. • Hand brake (trailer) control valve, lines, fittings, and mountings; repair or replace as needed. • Brake relay valve; replace as needed. • Quick release valves; replace as needed. • Tractor protection valve; replace as needed. • Emergency (spring) brake control/modulator valve(s); replace as needed. • Low pressure warning devices, wiring, and connectors; replace as needed.
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<p>fittings; replace as needed.</p> <p>k. Evaluate customer concerns of poor stopping, brake noise, premature wear, pulling, grabbing, or dragging problems caused by the foundation brake, slack adjuster, and brake chamber problems; determine needed action.</p> <p>l. Inspect and test service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; repair or replace as needed.</p> <p>m. Inspect and service manual and automatic slack adjusters; perform needed action.</p> <p>n. Inspect camshafts, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; replace as needed.</p> <p>o. Inspect and measure brake shoes, linings, or pads; perform needed action.</p> <p>p. Inspect and measure brake drums and rotors; perform needed action.</p> <p>q. Inspect and test parking (spring) brake chamber diaphragm and seals; replace parking (spring) brake chamber; dispose of removed chambers in accordance with local regulations.</p> <p>r. Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed.</p> <p>s. Inspect and test parking (spring) brake application and release valve; replace as needed.</p> <p>t. Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations.</p>	<ul style="list-style-type: none"> • Air pressure gauges, lines, and fittings; replace as needed. ○ Evaluate customer concerns of poor stopping, brake noise, premature wear, pulling, grabbing, or dragging problems caused by the foundation brake, slack adjuster, and brake chamber problems; determine needed action. ○ Inspect and test service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; repair or replace as needed. ○ Inspect and service manual and automatic slack adjusters; perform needed action. ○ Inspect camshafts, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; replace as needed. ○ Inspect and measure brake shoes, linings, or pads; perform needed action. ○ Inspect and measure brake drums and rotors; perform needed action. ○ Inspect and test parking (spring) brake chamber diaphragm and seals; replace parking (spring) brake chamber; dispose of removed chambers in accordance with local regulations. ○ Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed. ○ Inspect and test parking (spring) brake application and release valve; replace as needed. ○ Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
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3. Explore hydraulic brakes diagnosis and repair.
 - a. Evaluate customer concerns of poor stopping, premature wear, pulling, dragging or pedal feel problems caused by the hydraulic system; determine needed action.
 - b. Check brake pedal pushrod length; adjust as needed.
 - c. Inspect and test master cylinder for internal/external leaks and damage; replace as needed.
 - d. Inspect for leaks and damage, brake lines, flexible hoses, and fittings; replace as needed.
 - e. Inspect and test brake pressure differential valve and warning light circuit switch, bulbs, wiring, and connectors; repair or replace as needed.
 - f. Inspect and clean wheel cylinders; replace as needed.
 - g. Inspect and clean disc brake caliper assemblies; replace as needed.
 - h. Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type.
 - i. Test and adjust brake stop light switch, bulbs, wiring, and connectors; repair or replace as needed.
 - j. Inspect and measure brake drums and rotors; perform needed action.
 - k. Inspect and measure drum brake shoes and linings; inspect mounting hardware, adjuster mechanisms, and backing plates; perform needed action.
 - l. Inspect and measure disc brake pads/linings; inspect mounting hardware; perform needed action.
 - m. Check parking brake operation; inspect parking brake application and holding devices; adjust and replace as needed.

Teaching:

- The instructor will explain and demonstrate the following tasks. The student will perform the tasks.
 - Evaluate customer concerns of poor stopping, premature wear, pulling, dragging or pedal feel problems caused by the hydraulic system; determine needed action.
 - Check brake pedal pushrod length; adjust as needed.
 - Inspect and test master cylinder for internal/external leaks and damage; replace as needed.
 - Inspect for leaks and damage, brake lines, flexible hoses, and fittings; replace as needed.
 - Inspect and test brake pressure differential valve and warning light circuit switch, bulbs, wiring, and connectors; repair or replace as needed.
 - Inspect and clean wheel cylinders; replace as needed.
 - Inspect and clean disc brake caliper assemblies; replace as needed.
 - Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type.
 - Test and adjust brake stop light switch, bulbs, wiring, and connectors; repair or replace as needed.
 - Inspect and measure brake drums and rotors; perform needed action.
 - Inspect and measure drum brake shoes and linings; inspect mounting hardware, adjuster mechanisms, and backing plates; perform needed action.
 - Inspect and measure disc brake pads/linings; inspect mounting hardware; perform needed action.
 - Check parking brake operation; inspect parking brake application and holding devices; adjust and replace as needed.

Assessment:

- A checklist will be used for evaluation.

<p>4. Explore power assist units.</p> <ul style="list-style-type: none"> a. Evaluate customer concerns of stopping problems caused by the brake assist (booster) system; determine needed action. b. Inspect, test, repair, or replace power brake assist (booster), hoses, and control valves; determine proper fluid type. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ◦ Evaluate customer concerns of stopping problems caused by the brake assist (booster) system; determine needed action. ◦ Inspect, test, repair, or replace power brake assist (booster), hoses, and control valves; determine proper fluid type. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>5. Explore air and hydraulic antilock brake systems (ABS) and automatic traction control (ATC).</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ◦ Observe antilock brake system (ABS) warning light operation (includes dash mounted trailer ABS warning light); determine needed action. ◦ Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action. ◦ Evaluate customer concerns of poor stopping and wheel lock-up caused by failure of the antilock brake system (ABS); determine needed action. ◦ Diagnose, service, and adjust antilock brake system (ABS) wheel speed sensors and circuits following manufacturers' recommended procedures (including voltage output, resistance, shorts to voltage/ground, and frequency data). ◦ Observe automatic traction control (ATC) warning light operation; determine needed action. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.

STANDARDS*2004 ASE/NATEF Medium/Heavy Truck Technician Standards*

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTB2 Air Brakes Diagnosis and Repair.
- MTB3 Hydraulic Brakes System Diagnosis and Repair.
- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS2 Steering Systems Diagnosis and Repair.
- MTS3 Suspension Systems Diagnosis and Repair.
- MTS4 Wheel Alignment Diagnosis, Adjustment, and Repair.
- MTS5 Wheel and Tire Diagnosis and Repair.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD9 Engine Brakes.

Academic Standards

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.

- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

Suggested References

Automotive technology: The electronic classroom—Basic automotive. (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)

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Vehicle and Mobile Equipment Technician I

Unit 5: Basic Electrical Service and Electronic Controls

(170-200 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Explore general electrical systems diagnosis.</p> <ol style="list-style-type: none"> a. Read, interpret, and diagnose electrical/electronic circuits using wiring diagrams. b. Check continuity in electrical/electronic circuits using appropriate test equipment. c. Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using a digital multimeter (DMM). d. Check current flow in electrical/electronic circuits and components using a digital multimeter (DMM) or clamp-on ammeter. e. Check resistance in electrical/electronic circuits and components using a digital multimeter (DMM). f. Find shorts, grounds, and opens in electrical/electronic circuits. g. Diagnose parasitic (key-off) battery drain problems. h. Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed. i. Inspect and test spike suppression diodes/resistors; replace as needed. 	<p>Teaching:</p> <p>Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.</p> <ul style="list-style-type: none"> • The instructor will present a video on the given task. The student will develop several questions and answers from the video.^{E1} • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concerns.^{E1, E2, E3, E5, E8, E9, E10} • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task.^{E4, E3, E5} • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. <p>Assessment:</p> <ul style="list-style-type: none"> • The questions and answers will be evaluated for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks.
<p>2. Explore battery diagnosis and repair.</p> <ol style="list-style-type: none"> a. Perform battery load test; determine needed action. b. Determine battery state of charge using an open circuit voltage test. c. Inspect, clean, and service battery; replace as needed. d. Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ○ Perform battery load test; determine needed action. ○ Determine battery state of charge using an open circuit voltage test. ○ Inspect, clean, and service battery; replace as needed.

<ul style="list-style-type: none"> e. Charge battery using slow or fast charge method as appropriate. f. Inspect, test, and clean battery cables and connectors; repair or replace as needed. g. Jump start a vehicle using jumper cables and a booster battery or auxiliary power supply using proper safety procedures. 	<ul style="list-style-type: none"> o Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed. o Charge battery using slow or fast charge method as appropriate. o Inspect, test, and clean battery cables and connectors; repair or replace as needed. o Jump start a vehicle using jumper cables and a booster battery or auxiliary power supply using proper safety procedures. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>3. Explore starting system diagnosis and repair.</p> <ul style="list-style-type: none"> a. Perform starter circuit cranking voltage and voltage drop tests; determine needed action. b. Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed. c. Inspect and test starter relays and solenoids/switches; replace as needed. d. Remove and replace starter; inspect flywheel ring gear or flex plate. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> o Perform starter circuit cranking voltage and voltage drop tests; determine needed action. o Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed. o Inspect and test starter relays and solenoids/switches; replace as needed. o Remove and replace starter; inspect flywheel ring gear or flex plate. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>4. Explore charging system diagnosis and repair.</p> <ul style="list-style-type: none"> a. Diagnose instrument panel mounted volt meters and/or indicator lamps that show a no charge, low charge, or overcharge condition; determine needed action. b. Diagnose the cause of a no charge, low charge, or overcharge condition; determine needed action. c. Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> o Diagnose instrument panel mounted volt meters and/or indicator lamps that show a no charge, low charge, or overcharge condition; determine needed action. o Diagnose the cause of a no charge, low charge, or overcharge condition; determine needed action. o Inspect and replace alternator drive

<p>and check alignment.</p> <ul style="list-style-type: none"> d. Perform charging system voltage and amperage output tests; determine needed action. e. Perform charging circuit voltage drop tests; determine needed action. f. Remove and replace alternator. g. Inspect, repair, or replace connectors and wires in the charging circuit. 	<p>belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment.</p> <ul style="list-style-type: none"> o Perform charging system voltage and amperage output tests; determine needed action. o Perform charging circuit voltage drop tests; determine needed action. o Remove and replace alternator. o Inspect, repair, or replace connectors and wires in the charging circuit. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>5. Explore lighting system diagnosis and repair (headlights, daytime running lights, parking, clearance, tail, cab, and instrument panel lights).</p> <ul style="list-style-type: none"> a. Diagnose the cause of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation. b. Test, aim, and replace headlights. c. Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets and control components; repair or replace as needed. d. Inspect and test switches, bulbs/LEDs, sockets, connectors, terminals, relays and wires of parking, clearance, and taillight circuits; repair or replace as needed. e. Inspect and test instrument panel light circuit switches, relays, bulbs, sockets, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed. f. Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, and wires; repair or replace as needed. g. Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> o Diagnose the cause of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation. o Test, aim, and replace headlights. o Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets and control components; repair or replace as needed. o Inspect and test switches, bulbs/LEDs, sockets, connectors, terminals, relays and wires of parking, clearance, and taillight circuits; repair or replace as needed. o Inspect and test instrument panel light circuit switches, relays, bulbs, sockets, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed. o Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, and wires; repair or replace as needed. o Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed.

	Assessment: <ul style="list-style-type: none"> • A checklist will be used for evaluation.
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STANDARDS

2004 ASE/NATEF Medium/Heavy Truck Technician Standards

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTB2 Air Brakes Diagnosis and Repair.
- MTB3 Hydraulic Brakes System Diagnosis and Repair.
- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTE8 Related Electrical Systems.
- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS2 Steering Systems Diagnosis and Repair.
- MTS3 Suspension Systems Diagnosis and Repair.
- MTS4 Wheel Alignment Diagnosis, Adjustment, and Repair.
- MTS5 Wheel and Tire Diagnosis and Repair.
- MTS6 Frame Service and Repair.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD2 General Engine Diagnosis.
- MTD3 Cylinder Head and Valve Train Diagnosis and Repair.
- MTD4 Engine Block Diagnosis and Repair.
- MTD5 Lubrication Systems Diagnosis and Repair.

- MTD6 Cooling System Diagnosis and Repair.
 MTD7 Air Induction, and Exhaust Systems Diagnosis and Repair.
 MTD8 Fuel System Diagnosis and Repair.
 MTD9 Engine Brakes.

Academic Standards

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
 E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
 E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
 E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
 E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
 E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
 E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
 E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
 WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
 WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
 WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
 WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T2 Social, ethical, and human issues
 T3 Technology productivity tools
 T4 Technology communications tools
 T5 Technology research tools
 T6 Technology problem-solving and decision-making tools

Suggested References

- Automotive technology: The electronic classroom—Basic automotive.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Brakes.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Electrical/electronics.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Steering and suspension.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology curriculum—Basic automotive.* (2003). Columbia, MO: Instructional Materials Laboratory. (Instructor guide, student guide, workbook, CD-ROM, student task list, and transparencies available)
- Automotive technology curriculum—Brakes.* (2003). Columbia, MO: Instructional Materials Laboratory. (Instructor guide, student guide, workbook, CD-ROM, student task list, and transparencies available)
- Automotive technology curriculum—Electrical/electronics.* (2003). Columbia, MO: Instructional Materials Laboratory. (Instructor guide, student guide, workbook, CD-ROM, student task list, and transparencies available)
- Automotive technology curriculum—Steering and suspension.* (2003). Columbia, MO: Instructional Materials Laboratory. (Instructor guide, student guide, workbook, CD-ROM, student task list, and transparencies available)
- Barbieri, D., Kellum, M., & Miller, R. (1998). *Diesel technology: Engines.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.
- Eichhorn, L., & Joerschke, J. (2001). *Diesel technology: Introduction.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.
- Hilley, R., Kellum, M., & Scarberry, T. (2000). *Diesel technology: Brakes.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.

Vehicle and Mobile Equipment Technician II

Unit 1: Introduction, Orientation, Employability Skills, and Safety

(3-10 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Describe local program and vocational/career technical center policies and procedures.</p> <p>a. Describe local program and vocational/career technical center policies and procedures including dress code, attendance, academic requirements, discipline, and transportation regulations.</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • Present local program and vocational/career technical center policies and procedures. • Students will read the handbook to become aware of what is expected of them in relation to the policies and procedures of the school. This will include dress code, attendance, academic requirements, discipline, and transportation regulations. Students will work together in pairs. A student with a higher reading ability will team up with a student with a lower reading ability to get a better understanding of the school's program policies and procedures.^{E2, E3, E8} <p>Assessment:</p> <ul style="list-style-type: none"> • Students will have a written test on applicable policies and procedures. • Assess student orientation knowledge through instructor observations and written unit test. File completed test to document student mastery of the school and program policies and procedures.
<p>2. Describe employment opportunities and responsibilities.</p> <p>a. Describe employment opportunities including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements.</p> <p>b. Describe basic employee responsibilities.</p> <p>c. Design a resume and complete a job application.</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • Define trade terms related to basic employability skills. • Students will interview individuals in the automotive industry. Students will be provided questions by the instructor. The student will write a report on the interview and present the report to the class.^{E1} • Students will research the phone book (yellow pages), Internet, and newspapers for employment opportunities.^{E3} • Students will participate in a mock interview. Industry representatives will interview students. A checklist will be used to evaluate each student. • Guest speaker on industry related information.

	<ul style="list-style-type: none"> • The instructor will explain the contents of a cover letter and resume. Examples of cover letters and resumes will be given to the students. The student will design a cover letter and resume. • The instructor will discuss a job application. The student will obtain and complete a job application from a local business. • Students will use career software, such as Choices, to measure their aptitudes and abilities for particular careers.^{E3, E8} • Students will use the Internet to research a list of careers for which they will be qualified upon program completion.^{E2, E3, E4, E5, E10} • Students will use available resources (college catalogs and college websites) to research information about postsecondary educational opportunities.^{E2, E3, E4, E5, E10} • Students will select a career in the field and outline educational and skill requirements, expected job growth, and entry-level salaries.^{E1, E3, E8, E9} <p>Assessment:</p> <ul style="list-style-type: none"> • Assessment will be determined by matching test for definitions. Lessons involving writing and math skills will be integrated with the appropriate department. • The presentation on the industry interview will be evaluated using the presentation rubric and/or checklist. The report will be evaluated for a grade. • Use a checklist to evaluate the resume and cover letter. • A rubric will be used to evaluate the job application. • Use a checklist to evaluate the presentation. • Review career software printout to assess student aptitudes and abilities.
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<p>3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA.</p> <ul style="list-style-type: none"> a. Demonstrate effective teambuilding and leadership skills. b. Practice appropriate work ethics. 	<p>Teaching:</p> <ul style="list-style-type: none"> • Discuss the role of a team member and leader. Assign the students roles within a team and have them role play a situation in which there is a conflict which must be resolved. Utilize the lessons from SkillsUSA or other resources to provide additional training.^{E3, E8} • Discuss appropriate work ethics standards. Have the students list what they believe to be the most common problems within the automotive profession. <p>Assessment:</p> <ul style="list-style-type: none"> • Assess the role play using a checklist for documentation. • Lessons from other resources should be assessed according to the recommended resource guide.
<p>4. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations.</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • Have the students perform an activity involving verbal instructions. Divide the students into groups and have one team be the customer and the other be the service advisor. The customer will describe the concern and the service advisor will provide an explanation of the processes that will need to be followed for them to properly diagnose the concern. Have the groups switch roles and repeat the process. <small>E2, E3, E4, E8</small> • The student will be given a work order. The work order will contain written instructions of a specific job. The student will complete the work order. <p>Assessment:</p> <ul style="list-style-type: none"> • The lesson will be assessed using a presentation rubric. • The work order will be evaluated using a checklist.

<p>5. Discuss the history of the automotive industry to include materials, terminology, and techniques.</p>	<p>Teaching:</p> <ul style="list-style-type: none"> Discuss the history of the automotive industry. Have the students research the history of the automotive industry and develop a short presentation. The students will present to the class.^{H1, H2} <p>Assessment:</p> <ul style="list-style-type: none"> Assess the presentation using a presentation checklist.
<p>6. Describe general safety rules for working in a shop/lab and industry.</p> <ol style="list-style-type: none"> Describe how to avoid on-site accidents. Explain the relationship between housekeeping and safety. Explain the importance of following all safety rules and company safety policies. Explain the importance of reporting all on-the-job injuries and accidents. Explain the need for evacuation policies and the importance of following them. Explain the employer’s substances abuse policy and how it relates to safety. Explain the safety procedures when working near pressurized or high temperature. 	<p>Teaching:</p> <p>This can be used for the entire unit.</p> <ul style="list-style-type: none"> Identify, discuss, and demonstrate terms, rules, and procedures related to shop/lab and industry safety.^{E3, E8} Required written tests will follow each section of guidelines for safety rules and procedures. Provide the students with a list of terms and have them define the terms. Pair the students to quiz each other on the definitions in preparation for a written exam.^{E2, E3, E4, E8} Use the guidelines provided for personal safety (i.e., clothing, jewelry, hair, eyes, and ears.) Divide the students into pairs and assign each pair one of the guidelines. Each pair will demonstrate the “do’s and don’ts” of the guideline. Have an industry speaker present to the class the necessity of safety in the work environment. The students will write a summary of the presentation.^{E1, E2, E9} Divide the students into teams and have them develop scenarios of hazards and accidents using the publications, and the Internet. This will include tools, spills, working around welding, improper use of barriers, ladders or scaffolds, use of MSDS information, fires, and electrical situations. In a game type situation, one team will read a scenario and the other teams will compete to be the first to provide the proper safety measures which should have been used to prevent the hazardous situation or accident. Points will be awarded to the teams with
<p>7. Identify and apply safety around automotive operations.</p> <ol style="list-style-type: none"> Use proper safety practices when performing automotive operations. Recognize and explain personal protective equipment. Inspect and care for personal protective equipment. 	
<p>8. Explain lifting.</p> <ol style="list-style-type: none"> Identify and explain the procedures for lifting heavy objects. 	
<p>9. Explain the Material Safety Data Sheet (MSDS).</p> <ol style="list-style-type: none"> Explain the function of the MSDS. Interpret the requirements of the MSDS. 	

<p>10. Explain fires.</p> <ol style="list-style-type: none"> a. Explain the process by which fires start. b. Explain fire prevention of various flammable liquids. c. Explain the classes of fire and the types of extinguishers. 	<p>the correct answers.^{E2, E4}</p> <ul style="list-style-type: none"> • Required written tests will follow each section of guidelines for safety rules and procedures. • NOTE: SAFETY IS TO BE TAUGHT AS AN ONGOING PART OF THE COURSE THROUGHOUT THE YEAR. <p>Assessment:</p> <ul style="list-style-type: none"> • Student participation will be monitored by the instructor and the written exam will be graded. The student must achieve 100 % accuracy. • The “do’s and don’ts” exercise will be critiqued with a peer review. • The summary of the speaker’s presentation will be critiqued using a rubric. • The teams will be rewarded according the points earned from the game. This could be extra points, classroom privileges, etc. • Written exams will be graded.
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STANDARDS

2004 ASE/NATEF Medium/Heavy Truck Technician Standards

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTB2 Air Brakes Diagnosis and Repair.
- MTB3 Hydraulic Brakes System Diagnosis and Repair.
- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTE8 Related Electrical Systems.

- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS2 Steering Systems Diagnosis and Repair.
- MTS3 Suspension Systems Diagnosis and Repair.
- MTS4 Wheel Alignment Diagnosis, Adjustment, and Repair.
- MTS5 Wheel and Tire Diagnosis and Repair.
- MTS6 Frame Service and Repair.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD2 General Engine Diagnosis.
- MTD3 Cylinder Head and Valve Train Diagnosis and Repair.
- MTD4 Engine Block Diagnosis and Repair.
- MTD5 Lubrication Systems Diagnosis and Repair.
- MTD6 Cooling System Diagnosis and Repair.
- MTD7 Air Induction, and Exhaust Systems Diagnosis and Repair.
- MTD8 Fuel System Diagnosis and Repair.
- MTD9 Engine Brakes.

Academic Standards

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- E10 Use language and critical thinking strategies to serve as tools for learning.
- H1 Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

Suggested References

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- Automotive technology curriculum—Steering and suspension.* (2003). Columbia, MO: Instructional Materials Laboratory. (Instructor guide, student guide, workbook, CD-ROM, student task list, and transparencies available)
- Barbieri, D., Kellum, M., & Miller, R. (1998). *Diesel technology: Engines.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.
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Vehicle and Mobile Equipment Technician II
Unit 2: Advanced Tools, Technical References, Measurement, and Fasteners (5-15 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Demonstrate safe and proper use and storage of tools and equipment in an automotive shop.</p> <ul style="list-style-type: none"> a. Identify and demonstrate the safe and proper use of common hand tools including welders (ARC/MIG) and Oxy/Fuel cutting unit, wrenches, sockets, pliers, screwdrivers, striking tools, etc. b. Identify and demonstrate the safe and proper use of lifting and hoisting equipment. c. Identify and demonstrate the safe and proper use of cleaning equipment. d. Identify and demonstrate the safe and proper use of power equipment including impact wrenches, drills, grinders, and presses. e. Organize and maintain a systematic storage system for hand and power tools. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will review automotive supply catalogs and self-made pictures of tools and equipment that students will use in the program.^{E8} • The instructor will discuss and demonstrate safety procedures, proper use, and storage of tools and equipment. The student will demonstrate safety procedures, proper use, and storage of tools and equipment. A specific task will be assigned to a group of students. The group will make a list of the proper tools that will be required to complete the task and present their decisions to the class.^{E2, E4, E5} • The instructor will explain and demonstrate the use of software for the specific area of instruction. The student will use the software for tool identification.^{E3} <p>Assessment:</p> <ul style="list-style-type: none"> • A tool identification test. • A job sheet will be evaluated for the task and a rubric for the presentation. • The results from the software test will be printed and evaluated.
<p>2. Locate and apply service specifications and information.</p> <ul style="list-style-type: none"> a. Locate service specifications and information, using both print and computerized service information references. b. Interpret and apply information to a specific job on a specific vehicle. c. Locate and interpret vehicle and major component identification numbers (VIN, certification, and calibration labels). 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will review the text, Internet, manuals, and handouts for locating and applying information. The student will be assigned to locate specific information using text, Internet, manuals, and handouts for locating and information for an assigned task.^{E3, E8} <p>Assessment:</p> <ul style="list-style-type: none"> • The information will be recorded on the job sheet.

<p>3. Demonstrate measurement practices used in the automotive service.</p> <p>a. Measure the length of an object using a rule to the nearest 1/16th of an inch and 1 millimeter.</p> <p>b. Measure the inside diameter, outside diameter, and/or depth to the nearest .001 of an inch and nearest .1 millimeter, using precision measuring instruments (micrometers, calipers, and dial indicators).</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will give a worksheet on measurement. • The instructor will demonstrate how to measure a given item using a variety of measuring instruments. The student will measure given items and record the answers.^{E3,E8} • The instructor will explain and demonstrate software to review measuring skills. The student will use software to complete worksheets. <p>Assessment:</p> <ul style="list-style-type: none"> • A worksheet will be evaluated. • The student will measure given items and record on a job sheet for evaluation. • The worksheets will be evaluated.
<p>4. Identify common fasteners and describe their use.</p> <p>a. Identify the different types of bolts, nuts, and washers and describe their appropriate uses.</p> <p>b. Identify bolts by grade, diameter, length, and thread pitch.</p> <p>c. Identify different glues and sealants used in automotive service, and describe their appropriate use.</p> <p>d. Restore internal and external threads.</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and show fasteners using catalogs. The instructor will display several models that the students can view and manipulate. The students will analyze the fasteners, apply the proper fasteners, and present the decisions to the class.^{E3} <p>Assessment:</p> <ul style="list-style-type: none"> • A rubric will be used for evaluation.

STANDARDS

2004 ASE/NATEF Medium/Heavy Truck Technician Standards

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTB2 Air Brakes Diagnosis and Repair.
- MTB3 Hydraulic Brakes System Diagnosis and Repair.
- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTE8 Related Electrical Systems.
- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS2 Steering Systems Diagnosis and Repair.
- MTS3 Suspension Systems Diagnosis and Repair.
- MTS4 Wheel Alignment Diagnosis, Adjustment, and Repair.
- MTS5 Wheel and Tire Diagnosis and Repair.
- MTS6 Frame Service and Repair.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD2 General Engine Diagnosis.
- MTD3 Cylinder Head and Valve Train Diagnosis and Repair.
- MTD4 Engine Block Diagnosis and Repair.
- MTD5 Lubrication Systems Diagnosis and Repair.
- MTD6 Cooling System Diagnosis and Repair.
- MTD7 Air Induction, and Exhaust Systems Diagnosis and Repair.
- MTD8 Fuel System Diagnosis and Repair.
- MTD9 Engine Brakes.

Academic Standards

- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

Suggested References

- Automotive technology: The electronic classroom—Basic automotive.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Brakes.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Electrical/electronics.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
- Automotive technology: The electronic classroom—Steering and suspension.* (2004). Upper Saddle River, NJ: Pearson Education. (Text and DVD available)
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Barbieri, D., Kellum, M., & Miller, R. (1998). *Diesel technology: Engines.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.

Eichhorn, L., & Joerschke, J. (2001). *Diesel technology: Introduction.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.

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Vehicle and Mobile Equipment Technician II

Unit 3: Advanced Electrical Services and Electronic Controls

(20-25 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Explore stoplights, turn signals, hazard lights, and back-up lights.</p> <ol style="list-style-type: none"> a. Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, and wires; repair or replace as needed. b. Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, and wires; repair or replace as needed. c. Inspect, test, and adjust backup lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, and wires; repair or replace as needed. 	<p>Teaching:</p> <p>Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.</p> <ul style="list-style-type: none"> • The instructor will present a video on the given task. The student will develop several questions and answers from the video. ^{E1} • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concerns. ^{E1, E2, E3, E5, E8, E9, E10} • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task. ^{E3, E4, E5} • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. • The instructor will explain and demonstrate each task. The student will perform the tasks. <ul style="list-style-type: none"> ◦ Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, and wires; repair or replace as needed. ◦ Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, and wires; repair or replace as needed. ◦ Inspect, test, and adjust backup lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, and wires; repair or replace as needed. <p>Assessment:</p> <ul style="list-style-type: none"> • The questions and answers will evaluate for content and clarity.

	<ul style="list-style-type: none"> • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks. • A checklist will be used for evaluation.
<p>2. Explore gauges and warning devices diagnosis and repair.</p> <ol style="list-style-type: none"> Interface with vehicle’s on-board computer; perform diagnostic procedure using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action. Diagnose the cause of intermittent, high, low, or no gauge readings; determine needed action. Inspect and test gauge circuit sending units, gauges, connectors, terminals, and wires; repair or replace as needed. Inspect and test warning devices (lights and audible) circuit sending units, bulbs/LEDs, sockets, connectors, wires, and printed circuits/control modules; repair or replace as needed. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ◦ Interface with vehicle’s on-board computer; perform diagnostic procedure using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action. ◦ Diagnose the cause of intermittent, high, low, or no gauge readings; determine needed action. ◦ Inspect and test gauge circuit sending units, gauges, connectors, terminals, and wires; repair or replace as needed. ◦ Inspect and test warning devices (lights and audible) circuit sending units, bulbs/LEDs, sockets, connectors, wires, and printed circuits/control modules; repair or replace as needed. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>3. Explore related electrical systems.</p> <ol style="list-style-type: none"> Diagnose the cause of constant, intermittent, or no horn operation; determine needed action. Inspect and test horn circuit relays, horns, switches, connectors, and wires; repair or replace as needed. Diagnose the cause of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems; determine needed action. Inspect and test wiper motor, resistors, park switch, relays, switches, 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ◦ Diagnose the cause of constant, intermittent, or no horn operation; determine needed action. ◦ Inspect and test horn circuit relays, horns, switches, connectors, and wires; repair or replace as needed. ◦ Diagnose the cause of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems;

<p>connectors, and wires; repair or replace as needed.</p> <p>e. Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed.</p> <p>f. Inspect and test windshield washer motor or pump/relay assembly, switches, connectors, terminals, and wires; repair or replace as needed.</p> <p>g. Inspect and test heater and A/C electrical components including A/C clutches, motors, resistors, relays, switches, connectors, terminals, and wires; repair or replace as needed.</p> <p>h. Diagnose the cause of slow, intermittent, or no power side window operation; determine needed action.</p> <p>i. Inspect and test motors, switches, relays, connectors, terminals, and wires of power side window circuits; repair or replace as needed.</p> <p>j. Inspect block heaters; determine needed repairs.</p> <p>k. Inspect and test engine cooling fan electrical control components; repair or replace as needed.</p>	<p>determine needed action.</p> <ul style="list-style-type: none"> o Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, and wires; repair or replace as needed. o Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed. o Inspect and test windshield washer motor or pump/relay assembly, switches, connectors, terminals, and wires; repair or replace as needed. o Inspect and test heater and A/C electrical components including A/C clutches, motors, resistors, relays, switches, connectors, terminals, and wires; repair or replace as needed. o Diagnose the cause of slow, intermittent, or no power side window operation; determine needed action. o Inspect and test motors, switches, relays, connectors, terminals, and wires of power side window circuits; repair or replace as needed. o Inspect block heaters; determine needed repairs. o Inspect and test engine cooling fan electrical control components; repair or replace as needed. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
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STANDARDS

2004 ASE/NATEF Medium/Heavy Truck Technician Standards

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTB2 Air Brakes Diagnosis and Repair.
- MTB3 Hydraulic Brakes System Diagnosis and Repair.
- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices

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- associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTE8 Related Electrical Systems.
- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS2 Steering Systems Diagnosis and Repair.
- MTS3 Suspension Systems Diagnosis and Repair.
- MTS4 Wheel Alignment Diagnosis, Adjustment, and Repair.
- MTS5 Wheel and Tire Diagnosis and Repair.
- MTS6 Frame Service and Repair.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD2 General Engine Diagnosis.
- MTD3 Cylinder Head and Valve Train Diagnosis and Repair.
- MTD4 Engine Block Diagnosis and Repair.
- MTD5 Lubrication Systems Diagnosis and Repair.
- MTD6 Cooling System Diagnosis and Repair.
- MTD7 Air Induction, and Exhaust Systems Diagnosis and Repair.
- MTD8 Fuel System Diagnosis and Repair.
- MTD9 Engine Brakes.

Academic Standards

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.

- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

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Vehicle and Mobile Equipment Technician II
Unit 4: Diesel Systems and Theory

(169-205 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Explore general diesel engine diagnosis. Inspect fuel, oil, and coolant levels, condition, and consumption; determine needed action.</p> <p>a. Diagnose causes of engine fuel, oil, coolant, air, and other leaks; determine needed action.</p> <p>b. Interpret engine noises; determine needed action.</p> <p>c. Observe engine exhaust smoke color and quantity; determine needed action.</p> <p>d. Perform air intake system restriction and leakage tests; determine needed action.</p> <p>e. Perform intake manifold pressure (boost) test; determine needed action.</p> <p>f. Perform exhaust back pressure test; determine needed action.</p> <p>g. Perform crankcase pressure test; determine needed action.</p> <p>h. Diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action.</p> <p>i. Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action.</p> <p>j. Diagnose engine vibration problems; determine needed action.</p> <p>k. Check, record, and clear electronic diagnostic (fault) codes; monitor electronic data; determine needed action.</p> <p>l. Perform cylinder compression test; determine needed action.</p>	<p>Teaching: Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.</p> <ul style="list-style-type: none"> • The instructor will present a video on the given task. The student will develop several questions and answers from the video.^{E1} • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concerns.^{E1, E2, E3, E5, E8, E9, E10} • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task.^{E3, E4, E5} • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. • The instructor will explain and demonstrate each task. The student will perform the tasks. <ul style="list-style-type: none"> ○ Inspect fuel, oil, and coolant levels, condition, and consumption; determine needed action. ○ Diagnose causes of engine fuel, oil, coolant, air, and other leaks; determine needed action. ○ Interpret engine noises; determine needed action. ○ Observe engine exhaust smoke color and quantity; determine needed action. ○ Perform air intake system restriction and leakage tests; determine needed action. ○ Perform intake manifold pressure (boost) test; determine needed action. ○ Perform exhaust back pressure test; determine needed action.

	<ul style="list-style-type: none"> ○ Perform crankcase pressure test; determine needed action. ○ Diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action. ○ Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action. ○ Diagnose engine vibration problems; determine needed action. ○ Check, record, and clear electronic diagnostic (fault) codes; monitor electronic data; determine needed action. ○ Perform cylinder compression test; determine needed action. <p>Assessment:</p> <ul style="list-style-type: none"> • The questions and answers will evaluate for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks. • A checklist will be used for evaluation.
<p>2. Explore cylinder head and valve train diagnosis and repair.</p> <ul style="list-style-type: none"> a. Remove, clean, inspect for visible damage, and replace cylinder head(s) assembly. b. Clean and inspect threaded holes, studs, and bolts for serviceability; determine needed action. c. Inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action. d. Disassemble head and inspect valves, guides, seats, springs, retainers, 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ○ Remove, clean, inspect for visible damage, and replace cylinder head(s) assembly. ○ Clean and inspect threaded holes, studs, and bolts for serviceability; determine needed action. ○ Inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action. ○ Disassemble head and inspect valves,

<p>rotators, locks, and seals; determine needed action.</p> <ul style="list-style-type: none"> e. Measure valve head height relative to deck and valve face-to-seat contact; determine needed action. f. Inspect injector sleeves and seals; measure injector tip or nozzle protrusion; perform needed action. g. Reassemble cylinder head. h. Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash. i. Inspect pushrods, rocker arms, rocker arm shafts, electronic wiring harness, and brackets for wear, bending, cracks, looseness, and blocked oil passages; perform needed action. j. Inspect cam followers; perform needed action. k. Adjust valve clearance. 	<p>guides, seats, springs, retainers, rotators, locks, and seals; determine needed action.</p> <ul style="list-style-type: none"> o Measure valve head height relative to deck and valve face-to-seat contact; determine needed action. o Inspect injector sleeves and seals; measure injector tip or nozzle protrusion; perform needed action. o Reassemble cylinder head. o Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash. o Inspect pushrods, rocker arms, rocker arm shafts, electronic wiring harness, and brackets for wear, bending, cracks, looseness, and blocked oil passages; perform needed action. o Inspect cam followers; perform needed action. o Adjust valve clearance. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>3. Explore engine block diagnosis and repair.</p> <ul style="list-style-type: none"> a. Remove, inspect, service, and install pans, covers, vents, gaskets, seals, and wear rings. b. Disassemble, clean, and inspect engine block for cracks/damage; measure mating surfaces for warpage; check condition of passages, core/expansion and gallery plugs; inspect threaded holes, studs, dowel pins, and bolts for serviceability; determine needed action. c. Inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed action. d. Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed action. e. Replace/reinstall cylinder liners and seals; check and adjust liner height (protrusion). 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> o Remove, inspect, service, and install pans, covers, vents, gaskets, seals, and wear rings. o Disassemble, clean, and inspect engine block for cracks/damage; measure mating surfaces for warpage; check condition of passages, core/expansion and gallery plugs; inspect threaded holes, studs, dowel pins, and bolts for serviceability; determine needed action. o Inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed action. o Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed action. o Replace/reinstall cylinder liners and

<ul style="list-style-type: none"> f. Inspect in-block camshaft bearings for wear and damage; determine needed action. g. Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play. h. Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action. i. Inspect main bearings for wear patterns and damage; replace as needed; check bearing clearances; check and adjust crankshaft end play. j. Inspect, install, and time gear train; measure gear backlash; determine needed action. k. Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings; perform needed action. l. Determine piston-to-cylinder wall clearance; check ring-to-groove clearance and end gap; install rings on pistons. m. Assemble pistons and connecting rods; install in block; install rod bearings and check clearances. n. Install and align flywheel housing; inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action. o. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action. 	<ul style="list-style-type: none"> seals; check and adjust liner height (protrusion). o. Inspect in-block camshaft bearings for wear and damage; determine needed action. o. Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play. o. Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action. o. Inspect main bearings for wear patterns and damage; replace as needed; check bearing clearances; check and adjust crankshaft end play. o. Inspect, install, and time gear train; measure gear backlash; determine needed action. o. Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings; perform needed action. o. Determine piston-to-cylinder wall clearance; check ring-to-groove clearance and end gap; install rings on pistons. o. Assemble pistons and connecting rods; install in block; install rod bearings and check clearances. o. Install and align flywheel housing; inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action. o. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
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<p>4. Explore lubrication systems diagnosis and repair.</p> <ol style="list-style-type: none"> a. Test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit; determine needed action. b. Check engine oil level, condition, and consumption; determine needed action. c. Inspect and measure oil pump, drives, inlet pipes, and pick-up screens; determine needed action. d. Inspect, clean, and test oil cooler and components; determine needed action. e. Inspect turbocharger lubrication system; determine needed action. f. Determine proper lubricant and perform oil and filter change. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ○ Test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit; determine needed action. ○ Check engine oil level, condition, and consumption; determine needed action. ○ Inspect and measure oil pump, drives, inlet pipes, and pick-up screens; determine needed action. ○ Inspect, clean, and test oil cooler and components; determine needed action. ○ Inspect turbocharger lubrication system; determine needed action. ○ Determine proper lubricant and perform oil and filter change. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>5. Explore cooling system diagnosis and repair.</p> <ol style="list-style-type: none"> a. Check engine coolant type, level, condition, and consumption; determine needed action. b. Test coolant temperature and check operation of temperature sensor, gauge, and/or sending unit; determine needed action. c. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment. d. Inspect thermostat(s), by passes, housing(s), and seals; replace as needed. e. Test coolant for freeze protection and additive package concentration; adjust as needed. f. Recover, flush, and refill with recommended coolant/additive package; bleed cooling system. g. Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ○ Check engine coolant type, level, condition, and consumption; determine needed action. ○ Test coolant temperature and check operation of temperature sensor, gauge, and/or sending unit; determine needed action. ○ Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment. ○ Inspect thermostat(s), by passes, housing(s), and seals; replace as needed. ○ Test coolant for freeze protection and additive package concentration; adjust as needed. ○ Recover, flush, and refill with recommended coolant/additive package; bleed cooling system. ○ Inspect coolant conditioner/filter

<ul style="list-style-type: none"> h. Inspect water pump and hoses; replace as needed. i. Inspect, clean, and pressure test radiator, pressure cap, tank(s), and recovery systems; determine needed action. j. Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed. 	<p>assembly for leaks; inspect valves, lines, and fittings; replace as needed.</p> <ul style="list-style-type: none"> o Inspect water pump and hoses; replace as needed. o Inspect, clean, and pressure test radiator, pressure cap, tank(s), and recovery systems; determine needed action. o Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>6. Explore air induction and exhaust systems diagnosis and repair.</p> <ul style="list-style-type: none"> a. Check air induction system (piping, hoses, clamps, and mounting); check for air restrictions and leaks; service or replace air filter as needed. b. Inspect intake manifold, gaskets, and connections; replace as needed. c. Inspect exhaust manifold, piping, mufflers, exhaust after-treatment device(s), and mounting hardware; repair or replace as needed. d. Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action. e. Inspect and test exhaust gas recirculation (EGR) system; determine needed action. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> o Check air induction system (piping, hoses, clamps, and mounting); check for air restrictions and leaks; service or replace air filter as needed. o Inspect intake manifold, gaskets, and connections; replace as needed. o Inspect exhaust manifold, piping, mufflers, exhaust after-treatment device(s), and mounting hardware; repair or replace as needed. o Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action. o Inspect and test exhaust gas recirculation (EGR) system; determine needed action. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>7. Explore fuel system diagnosis and repair.</p> <ul style="list-style-type: none"> a. Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply, and return lines and fittings; determine needed action. b. Inspect, clean, and test fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> o Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply, and return lines and fittings; determine needed action. o Inspect, clean, and test fuel transfer

<p>plates, and mounting hardware; determine needed action.</p> <p>c. Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determine needed action.</p> <p>d. Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump.</p>	<p>(lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates, and mounting hardware; determine needed action.</p> <ul style="list-style-type: none"> o Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determine needed action. o Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>8. Explore mechanical fuel injection diagnosis and repair.</p> <p>a. Inspect and adjust throttle control linkage; determine needed action.</p> <p>b. Inspect, test, and adjust engine fuel shut-down devices and controls; determine needed action.</p> <p>c. Inspect high pressure injection lines, hold downs, fittings and seals; replace as needed.</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> o Inspect and adjust throttle control linkage; determine needed action. o Inspect, test, and adjust engine fuel shut-down devices and controls; determine needed action. o Inspect high pressure injection lines, hold downs, fittings and seals; replace as needed. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>9. Explore electronic fuel management system diagnosis and repair.</p> <p>a. Inspect and test power and ground circuits and connections; measure and interpret voltage, voltage drop, amperage, and resistance readings using a digital multimeter (DMM); determine needed action.</p> <p>b. Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determine needed action.</p> <p>c. Locate and use relevant service</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> o Inspect and test power and ground circuits and connections; measure and interpret voltage, voltage drop, amperage, and resistance readings using a DMM; determine needed action. o Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determine

<p>information (to include diagnostic procedures, flow charts, and wiring diagrams).</p> <p>d. Inspect and replace electrical connector terminals, seals, and locks.</p> <p>e. Inspect and test switches, sensors, controls, actuator components, and circuits; adjust or replace as needed.</p> <p>f. Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), access and change customer parameters.</p> <p>g. Inspect, test, and adjust electronic unit injectors (EUI); determine needed action.</p> <p>h. Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable).</p> <p>i. Perform cylinder contribution test utilizing recommended electronic diagnostic tool.</p> <p>j. Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action.</p> <p>k. Perform on-engine inspections and tests on distributor-type injection pump electronic controls; determine needed action.</p> <p>l. Perform on-engine inspections and tests on in-line type injection pump electronic controls; determine needed action.</p> <p>m. Perform on-engine inspections and tests on common rail type injection systems; determine needed action.</p> <p>n. Discuss engine compression/exhaust brakes; determine needed action.</p>	<p>needed action.</p> <ul style="list-style-type: none"> o Locate and use relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams). o Inspect and replace electrical connector terminals, seals, and locks. o Inspect and test switches, sensors, controls, actuator components, and circuits; adjust or replace as needed. o Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), access and change customer parameters. o Inspect, test, and adjust electronic unit injectors (EUI); determine needed action. o Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable). o Perform cylinder contribution test utilizing recommended electronic diagnostic tool. o Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action. o Perform on-engine inspections and tests on distributor-type injection pump electronic controls; determine needed action. o Perform on-engine inspections and tests on in-line type injection pump electronic controls; determine needed action. o Perform on-engine inspections and tests on common rail type injection systems; determine needed action. o Discuss engine compression/exhaust brakes; determine needed action. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>10. Explore small engines.</p> <p>a. Describe the operation of a small</p>	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and

<p>gasoline engines.</p> <p>b. Perform service and repair of small gasoline engines.</p>	<p>demonstrate the following tasks. The student will perform the tasks.</p> <ul style="list-style-type: none"> o Describe the operation of small gasoline engines. o Perform service and repair of small gasoline engines. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
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STANDARDS

2004 ASE/NATEF Medium/Heavy Truck Technician Standards

- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTE8 Related Electrical Systems.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD2 General Engine Diagnosis.
- MTD3 Cylinder Head and Valve Train Diagnosis and Repair.
- MTD4 Engine Block Diagnosis and Repair.
- MTD5 Lubrication Systems Diagnosis and Repair.
- MTD6 Cooling System Diagnosis and Repair.
- MTD7 Air Induction, and Exhaust Systems Diagnosis and Repair.
- MTD8 Fuel System Diagnosis and Repair.
- MTD9 Engine Brakes.

Academic Standards

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.

- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

Suggested References

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- Eichhorn, L., & Joerschke, J. (2001). *Diesel technology: Introduction.* Stillwater, OK: Oklahoma Department of Vocational-Technical Education.
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Vehicle and Mobile Equipment Technician II
Unit 5: Steering and Suspension Systems

(73-90 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
<p>1. Explore steering systems diagnosis and repair.</p> <ul style="list-style-type: none"> a. Diagnose fixed and driver adjustable steering column and shaft noise, looseness, and binding problems; determine needed action. b. Inspect steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft U-joints; determine needed action. c. Check and adjust cab mounting and ride height. d. Center the steering wheel as needed. e. Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' procedures. f. Diagnose power steering system noise, steering binding, turning effort, looseness, hard steering, overheating, fluid leakage, and fluid aeration problems; determine needed action. g. Determine recommended type of power steering fluid; check level and condition; determine needed action. h. Flush and refill power steering system; purge air from system. i. Inspect, service, or replace power steering reservoir including filter, seals, and gaskets. j. Inspect and reinstall/replace pulleys, tensioners, and drive belts; adjust drive belts and check alignment. k. Inspect, adjust, or replace power steering pump, mountings, and brackets. l. Inspect and replace power steering system cooler, lines, hoses, clamps/mountings, hose routings, and fittings. m. Inspect, adjust, or replace linkage-assist type power steering cylinder or gear (dual system). 	<p>Teaching: Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.</p> <ul style="list-style-type: none"> • The instructor will present a video on the given task. The student will develop several questions and answers from the video.^{E1} • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concerns.^{E1, E2, E3, E5, E8, E9, E10} • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task.^{E3, E4, E5} • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. • The instructor will explain and demonstrate each task. The student will perform the tasks. <ul style="list-style-type: none"> ○ Diagnose fixed and driver adjustable steering column and shaft noise, looseness, and binding problems; determine needed action. ○ Inspect steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft U-joints; determine needed action. ○ Check and adjust cab mounting and ride height. ○ Center the steering wheel as needed. ○ Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' procedures. ○ Diagnose power steering system noise, steering binding, turning effort, looseness, hard steering, overheating,

<ul style="list-style-type: none"> n. Inspect, adjust, repair, or replace integral type power steering gear and mountings. o. Inspect and align pitman arm; replace as needed. p. Inspect drag link (relay rod) and tie rod ends; adjust or replace as needed. q. Inspect steering arm and levers, and linkage pivot joints; replace as needed. r. Inspect clamps and retainers on cross tube/relay rod/centerlink/tie rod; position or replace as needed. s. Check and adjust wheel stops. t. Lubricate steering linkage joints as needed. 	<p>fluid leakage, and fluid aeration problems; determine needed action.</p> <ul style="list-style-type: none"> o. Determine recommended type of power steering fluid; check level and condition; determine needed action. o. Flush and refill power steering system; purge air from system. o. Inspect, service, or replace power steering reservoir including filter, seals, and gaskets. o. Inspect and reinstall/replace pulleys, tensioners, and drive belts; adjust drive belts and check alignment. o. Inspect, adjust, or replace power steering pump, mountings, and brackets. o. Inspect and replace power steering system cooler, lines, hoses, clamps/mountings, hose routings, and fittings. o. Inspect, adjust, or replace linkage-assist type power steering cylinder or gear (dual system). o. Inspect, adjust, repair, or replace integral type power steering gear and mountings. o. Inspect and align pitman arm; replace as needed. o. Inspect drag link (relay rod) and tie rod ends; adjust or replace as needed. o. Inspect steering arm and levers, and linkage pivot joints; replace as needed. o. Inspect clamps and retainers on cross tube/relay rod/centerlink/tie rod; position or replace as needed. o. Check and adjust wheel stops. o. Lubricate steering linkage joints as needed. <p>Assessment:</p> <ul style="list-style-type: none"> • The questions and answers will evaluate for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity.
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	<ul style="list-style-type: none"> • A checklist will be used to evaluate the tasks. • A checklist will be used for evaluation.
<p>2. Explore suspension systems diagnosis and repair</p> <ol style="list-style-type: none"> Inspect front axles, U-bolts, and nuts; determine needed action. Inspect shock absorbers, bushings, brackets, and mounts; replace as needed. Inspect leaf springs, center bolts, clips, eye bolts and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed action. Inspect torque arms, bushings, and mounts; determine needed action. Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, and related bushings, mounts, shims, and cams; determine needed action. Inspect walking beams, center (cross) tube, bushings, mounts, load pads, and saddles/caps; replace as needed. Measure vehicle ride height; determine needed action. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ○ Inspect front axles, U-bolts, and nuts; determine needed action. ○ Inspect shock absorbers, bushings, brackets, and mounts; replace as needed. ○ Inspect leaf springs, center bolts, clips, eye bolts and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed action. ○ Inspect torque arms, bushings, and mounts; determine needed action. ○ Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, and related bushings, mounts, shims, and cams; determine needed action. ○ Inspect walking beams, center (cross) tube, bushings, mounts, load pads, and saddles/caps; replace as needed. ○ Measure vehicle ride height; determine needed action. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>3. Explore wheel alignment diagnosis, adjustment, and repair.</p> <ol style="list-style-type: none"> Evaluate customer concerns of vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problem(s); adjust and repair as needed. Check camber; determine needed action. Check caster; adjust as needed. Check toe; adjust as needed. Check rear axle(s) alignment (thrustline/centerline) and tracking; adjust or repair as needed. Check front axle alignment (centerline); adjust or repair as 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ○ Evaluate customer concerns of vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problem(s); adjust and repair as needed. ○ Check camber; determine needed action. ○ Check caster; adjust as needed. ○ Check toe; adjust as needed. ○ Check rear axle(s) alignment (thrustline/centerline) and tracking; adjust or repair as needed.

<p>needed.</p>	<ul style="list-style-type: none"> ○ Check front axle alignment (centerline); adjust or repair as needed. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>4. Explore wheels and tires diagnosis and repair.</p> <ul style="list-style-type: none"> a. Diagnose unusual tire wear patterns, check tread depth, and check for and check for mismatched tread design; determine needed action. b. Diagnose wheel/tire vibration, shimmy, pounding, hop (tramp) problems; determine needed action. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ○ Diagnose unusual tire wear patterns, check tread depth, and check for mismatched tread design; determine needed action. ○ Diagnose wheel/tire vibration, shimmy, pounding, hop (tramp) problems; determine needed action. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.
<p>5. Explore frame service and repair.</p> <ul style="list-style-type: none"> a. Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage; determine needed repairs. b. Inspect, install, or repair frame hangers, brackets, and cross members in accordance with manufacturers' recommended procedures. 	<p>Teaching:</p> <ul style="list-style-type: none"> • The instructor will explain and demonstrate the following tasks. The student will perform the tasks. <ul style="list-style-type: none"> ○ Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage; determine needed repairs. ○ Inspect, install, or repair frame hangers, brackets, and cross members in accordance with manufacturers' recommended procedures. <p>Assessment:</p> <ul style="list-style-type: none"> • A checklist will be used for evaluation.

STANDARDS

2004 ASE/NATEF Medium/Heavy Truck Technician Standards

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTB2 Air Brakes Diagnosis and Repair.
- MTB3 Hydraulic Brakes System Diagnosis and Repair.

- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTE8 Related Electrical Systems.
- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS2 Steering Systems Diagnosis and Repair.
- MTS3 Suspension Systems Diagnosis and Repair.
- MTS4 Wheel Alignment Diagnosis, Adjustment, and Repair.
- MTS5 Wheel and Tire Diagnosis and Repair.
- MTS6 Frame Service and Repair.

Academic Standards

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

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Recommended Tools and Equipment

CAPITALIZED ITEMS

1. Student Tool Kit (1 kit per 2 students)
 - a. Adjustable wrenches (6" and 12") (2)
 - b. Allen wrench sets, standard (.050" – 3/8") and metric (2mm – 7mm)
 - c. Brake spoon
 - d. Chisels – cape (5/16") and cold (3/8" & 3/4")
 - e. Claw type pickup tool
 - f. Combination wrench sets – standard (1/4" – 1") and metric (7mm – 19 mm)
 - g. Continuity test light (12v)
 - h. Feeler gauge (blade type) (.002" – .040") and (.006 mm – .070 mm)
 - i. Hack saw
 - j. Hammer – 16 oz. ball peen
 - k. Hammer plastic tip
 - l. Ignition wrench set – US and metric
 - m. Magnetic pickup tool
 - n. Pliers, combination 6", locking jaw, needle nose, side cutting, and slip joint (water pump)
 - o. Punches, center, brass drift, pin (1/8", 3/16", 1/4", 5/16"), and taper (3/8", 1/2", 5/8")
 - p. Scrapers – carbon 1" and gasket 1"
 - q. Screwdrivers – standard (stubby, 6", 9", 12", and offset) and Phillips (stubby #1, #2; 6" #1, #2; 12" #3)
 - r. Screw starters – standard and Phillips
 - s. Socket – set – 1/4" drive: 1/4" – 1/2" standard sockets, 1/4" – 1/2" deep sockets, 6mm – 12mm standard sockets, 6mm – 12mm deep sockets, flex/universal type handle, 3" and 6" extensions, ratchet
 - t. Socket set – 3/8" drive: 5/16" – 3/4" standard sockets; 3/8" – 3/4" deep sockets; 9mm – 19mm standard sockets; 9mm – 19mm deep sockets; 3", 6", 12", and 18" extensions; flex head ratchet; ratchet; speed handle; universal joint; spark plug sockets (5/8" and 13/16")
 - u. Socket set – 1/2" drive: 7/16" – 1 1/8" standard sockets; 7/16" – 1 1/8" deep sockets; 10mm – 25mm standard sockets; 10mm – 25mm deep sockets; 3", 6", and 12" extensions; flex/universal type handle, ratchet
 - v. Spark plug feeler gauge (gap tool)
2. Air compressor and hoses (1 per program)
3. Axle stands (6 sets per program)
4. Bench or pedestal grinder (2 per program)
5. Computer scan tool (hand-held) – on-board diagnostics level II (4 per program of various brands)
6. Diesel/gasoline fuel pressure testing gauge set with adaptors (1 per program)
7. Hoist(s), engine (1 per program)
8. Hydraulic press with adapters (25 ton) (1 per program)
9. Master puller set (1 per program)

10. Microcomputer with monitor, printer (CD-ROM and cables) (6 per program)
11. Microcomputer service information software (CD-ROM) (1 per computer)
12. Parts cleaning tank (1 per program)
13. Steel top workbenches with vises (1 per 2 students)
14. Tap and die set (US and metric) (2 per program)
15. Tire mounting machine (1 per program)
16. Wheel balancer (1 per program)
17. Brake lathe with disc service attachments with large vehicle attachments (1 per program)
18. Refrigerant recovery/recycling machine (R-12) (1 per program)
19. Refrigerant recovery/recycling machine (HFC-134a) (1 per program)
20. Battery/starter/charging system tester (1 per program)
21. Valve and valve seat resurfacing equipment (1 per program)
22. Valve spring tester (1 per program)
23. Diesel fuel injector nozzle pop tester (1 per program)
24. Arc/MIG welder with all accessories (1 per program)
25. Fuel system pressure testing gauge with adapters (1 per program)
26. Asbestos containment/removal device (1 per program)

NON-CAPITALIZED ITEMS

1. Air blow gun (OSHA approved) (2 per program)
2. Battery post cleaner (6 per program)
3. Battery terminal pliers (6 per program)
4. Battery terminal puller (6 per program)
5. Files – coarse 6" and 12", fine 6" and 12", half-round 12", and round 6" and 12" (2 sets per program)
6. Flare nut (tubing wrenches) 3/8" – 3/4" and 10mm – 17mm (1 set per program)
7. Flashlight (1 per tool box)
8. Fuel system pressure gauge with adapters (1 per program)
9. Hammer – dead blow plastic mallet (2 per program)
10. Jumper wire set (2 per program)
11. Pliers – hose clamp (2 per program)
12. Pry bars – rolling head and straight (2 per program)
13. Screwdriver set – Posidrive 7 #1 – #4 (2 set per program)
14. Screwdriver set – Torx 7 (T-8 – T-55) (2 sets per program)
15. 3/8" drive air ratchet (1 per program)
16. 3/8" drive impact sockets (US and metric) (2 sets per program)
17. 3/8" drive impact wrench (1 per program)
18. 3/8" drive flexible socket set (US and metric) (1 per program)
19. 1/2" drive air impact wrench (2 per program)
20. 1/2" drive impact sockets (US and metric) (2 sets per program)
21. Air chisel with various bits (1 per program)
22. Battery charger/booster starter (2 per program)
23. Belt tensioner gauge (1 per program)
24. Compression tester (3 per program)

25. Cooling system pressure tester (1 per program)
26. Floor creeper (1 per 2 students per class)
27. Cylinder leakage tester (2 per program)
28. Dial indicator with flex arm and clamp base (2 per program)
29. Digital multimeter with various lead sets (1 per 2 students per class)
30. Drain pans (6 per program)
31. Drill – 3/8" variable speed (6 per program)
32. Drill – 1/2" variable speed (2 per program)
33. Extension cords (6 per program)
34. Fender covers (10 per program)
35. Floor jack (1 1/2 ton minimum capacity) (3 per program)
36. Gear lube dispenser (1 per program)
37. Hand held vacuum pump (1 per program)
38. Hot plate (or equivalent) (1 per program)
39. Jumper cables (3 sets per program)
40. Outside micrometers (0 – 1", 1 – 2", 2 – 3", 3 – 4", 4 – 5") (4 sets per program)
41. Oil can – pump type (1 per program)
42. Oil filter wrench(es) various sizes (2 sets per program)
43. Pressure washer (1 per program)
44. Remote starter switch (2 per program)
45. Screw extractor set (2 per program)
46. Seat covers (10 per program)
47. Snap ring pliers set – external and internal (2 set per program)
48. Soldering gun (2 per program)
49. Soldering iron (25 watt pencil type) (2 per program)
50. Sparkplug boot puller (5 per program)
51. Tach/dwell meter (1 per program)
52. Thread repair insert kit (1 per program)
53. Tire inflator chuck (2 per program)
54. Trouble/work lights (1 per 2 students)
55. Tube quick disconnect tool set (1 per program)
56. Tubing cutter and flaring set (2 per program)
57. Twist steel drill bit set (1/64" – 1/2" (2 sets per program)
58. Valve core removal tool (2 per program)
59. Vernier calipers (0 – 6" and 0 – 125mm) (2 sets per program)
60. Waste oil receptacle (1 per program)
61. Ball joint press (1 per program)
62. Bearing packer (2 per program)
63. Brake pedal holder (1 per program)
64. Drag link tool (1 per program)
65. Inner tie rod end tool (1 per program)
66. Pitman arm puller (1 per program)
67. Shock absorber tools (1 per program)
68. Spring/strut compressor tool (1 per program)
69. Tie rod puller (1 per program)
70. Wheel weight pliers (1 per program)

71. Brake bleeder, pressure (1 per program)
72. Brake cylinder clamps (1 sets per program)
73. Brake disc micrometer (2 sets per program)
74. Brake drum micrometer (1 set per program)
75. Brake shoe adjusting gauge (2 per program)
76. Brake spring installers (6 per program)
77. Brake spring pliers (6 per program)
78. Air conditioner service port adapter set (1 per program)
79. Manifold gauge set (2 per program)
80. Antifreeze tester (2 per program)
81. Carburetor plug and angle gauge set (1 per program)
82. Computer carburetor tools (1 per program)
83. Cylinder leakage tester (2 per program)
84. Oxygen sensor socket (2 sets per program)
85. Sending unit socket (1 per program)
86. Sparkplug thread tap (1 per program)
87. Static strip (4 per program)
88. Timing advance light (4 per program)
89. Vacuum/pressure gauge set (2 per program)
90. Transmission jack(s) (1 per program)
91. Transmission holding fixtures (1 per program)
92. Transmission special tools set (1 per program)
93. Alternator service tools (1 per program)
94. Connector pick tool set (1 per program)
95. Wire and terminal repair kit (4 per program)
96. Clutch alignment set (1 per program)
97. Clutch pilot puller set (1 per program)
98. Universal joint tools (1 per program)
99. Valve guide repair unit (1 per program)
100. Valve spring compressor (1 per program)
101. Hydraulic pressure testing gauge (1 per program)
102. Oxyacetylene welding and cutting set (1 per program)

RECOMMENDED INSTRUCTIONAL AIDS

It is recommended that teachers have access to the following items:

1. Cart, AV (for TV-VCR) (1)
2. Cart, AV (for overhead projector) (1)
3. Mylar board (1)
4. Internet connection (1)
5. TV – VCR (1)
6. Video out (Microcomputer to TV monitor) (1)
7. Smart board

Student Competency Profile for Vehicle and Mobile Equipment Technician I

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction and Orientation

- ____ 1. Describe local program and vocational/career technical center policies and procedures.
- ____ 2. Describe employment opportunities and responsibilities.
- ____ 3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA.
- ____ 4. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations.
- ____ 5. Discuss the history of the automotive industry to include materials, terminology, and techniques.

Unit 2: Safety

- ____ 1. Describe general safety rules for working in a shop/lab and industry.
- ____ 2. Identify and apply safety around automotive operations.
- ____ 3. Explain lifting.
- ____ 4. Explain the Material Safety Data Sheet (MSDS).
- ____ 5. Explain fires.
- ____ 6. Explain safety in and around automotive and electrical situations.

Unit 3: Tools, Technical References, Measurement, and Fasteners

- ____ 1. Demonstrate safe and proper use and storage of tools and equipment in an automotive shop.
- ____ 2. Locate and apply service specifications and information.
- ____ 3. Demonstrate measurement practices used in the automotive service.
- ____ 4. Identify common fasteners and describe their use.

Unit 4: Brakes/Basic Hydraulics

- ____ 1. Explore air brake diagnosis and repair.
- ____ 2. Explore air supply and service systems.
- ____ 3. Explore hydraulic brakes diagnosis and repair.
- ____ 4. Explore power assist units.

- ____ 5. Explore air and hydraulic antilock brake systems (ABS) and automatic traction control (ATC).

Unit 5: Basic Electrical Service and Electronic Controls

- ____ 1. Explore general electrical systems diagnosis.
____ 2. Explore battery diagnosis and repair.
____ 3. Explore starting system diagnosis and repair.
____ 4. Explore charging system diagnosis and repair.
____ 5. Explore lighting system diagnosis and repair, (headlights, daytime running lights, parking, clearance, tail, cab, and instrument panel lights).

Student Competency Profile for Vehicle and Mobile Equipment Technician II

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction, Orientation, Employability Skills, and Safety

- _____ 1. Describe local program and vocational/career technical center policies and procedures.
- _____ 2. Describe employment opportunities and responsibilities.
- _____ 3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA.
- _____ 4. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations.
- _____ 5. Discuss the history of the automotive industry to include materials, terminology, and techniques.
- _____ 6. Describe general safety rules for working in a shop/lab and industry.
- _____ 7. Identify and apply safety around automotive operations.
- _____ 8. Explain lifting.
- _____ 9. Explain the Material Safety Data Sheet (MSDS).
- _____ 10. Explain fires.

Unit 2: Advanced Tools, Technical References, Measurement, and Fasteners

- _____ 1. Demonstrate safe and proper use and storage of tools and equipment in an automotive shop.
- _____ 2. Locate and apply service specifications and information.
- _____ 3. Demonstrate measurement practices used in the automotive service.
- _____ 4. Identify common fasteners and describe their use.

Unit 3: Advanced Electrical Service and Electronic Controls

- _____ 1. Explore stoplights, turn signals, hazard lights, and back-up lights.
- _____ 2. Explore gauges and warning devices diagnosis and repair.
- _____ 3. Explore related electrical systems.

Unit 4: Diesel Systems and Theory

- _____ 1. Explore general diesel engine diagnosis.
- _____ 2. Explore cylinder head and valve train diagnosis and repair.

- _____ 3. Explore engine block diagnosis and repair.
- _____ 4. Explore lubrication systems diagnosis and repair.
- _____ 5. Explore cooling system diagnosis and repair.
- _____ 6. Explore air induction and exhaust systems diagnosis and repair.
- _____ 7. Explore fuel system diagnosis and repair.
- _____ 8. Explore mechanical fuel injection diagnosis and repair.
- _____ 9. Explore electronic fuel management system diagnosis and repair.
- _____ 10. Explore small engines.

Unit 5: Steering and Suspension Systems

- _____ 1. Explore steering systems diagnosis and repair.
- _____ 2. Explore suspension systems diagnosis and repair.
- _____ 3. Explore wheel alignment diagnosis, adjustment, and repair.
- _____ 4. Explore wheels and tires diagnosis and repair.
- _____ 5. Explore frame service and repair.

Appendix A: 2004 ASE/NATEF Medium/Truck Technician Standards¹

- MTB1 For every task in Brakes the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTB2 Air Brakes Diagnosis and Repair.
- MTB3 Hydraulic Brakes System Diagnosis and Repair.
- MTE1 For every task in Electrical/Electronic Systems the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTE2 General Electrical System Diagnosis.
- MTE3 Battery Diagnosis and Service.
- MTE4 Starting System Diagnosis and Repair.
- MTE5 Charging System Diagnosis and Repair.
- MTE6 Lighting Systems Diagnosis and Repair.
- MTE7 Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair.
- MTE8 Related Electrical Systems.
- MTS1 For every task in Suspension and Steering the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTS2 Steering Systems Diagnosis and Repair.
- MTS3 Suspension Systems Diagnosis and Repair.
- MTS4 Wheel Alignment Diagnosis, Adjustment, and Repair.
- MTS5 Wheel and Tire Diagnosis and Repair.
- MTS6 Frame Service and Repair.
- MTD1 For every task in Diesel the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- MTD2 General Engine Diagnosis.
- MTD3 Cylinder Head and Valve Train Diagnosis and Repair.
- MTD4 Engine Block Diagnosis and Repair.
- MTD5 Lubrication Systems Diagnosis and Repair.
- MTD6 Cooling System Diagnosis and Repair.
- MTD7 Air Induction, and Exhaust Systems Diagnosis and Repair.

¹ 2004 ASE/NATEF Medium/Heavy Truck Technician standards. Retrieved August 10, 2004, from <http://www.natef.org>

MTD8 Fuel System Diagnosis and Repair.
MTD9 Engine Brakes.

Appendix B: Academic Standards

Algebra I²

Competencies and Suggested Objective(s)

- A1 Recognize, classify, and use real numbers and their properties.
- Describe the real number system using a diagram to show the relationships of component sets of numbers that compose the set of real numbers.
 - Model properties and equivalence relationships of real numbers.
 - Demonstrate and apply properties of real numbers to algebraic expressions.
 - Perform basic operations on square roots excluding rationalizing denominators.
- A2 Recognize, create, extend, and apply patterns, relations, and functions and their applications.
- Analyze relationships between two variables, identify domain and range, and determine whether a relation is a function.
 - Explain and illustrate how change in one variable may result in a change in another variable.
 - Determine the rule that describes a pattern and determine the pattern given the rule.
 - Apply patterns to graphs and use appropriate technology.
- A3 Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.
- Solve, check, and graph linear equations and inequalities in one variable, including rational coefficients.
 - Graph and check linear equations and inequalities in two variables.
 - Solve and graph absolute value equations and inequalities in one variable.
 - Use algebraic and graphical methods to solve systems of linear equations and inequalities.
 - Translate problem-solving situations into algebraic sentences and determine solutions.
- A4 Explore and communicate the characteristics and operations of polynomials.
- Classify polynomials and determine the degree.
 - Add, subtract, multiply, and divide polynomial expressions.
 - Factor polynomials using algebraic methods and geometric models.
 - Investigate and apply real-number solutions to quadratic equations algebraically and graphically.
 - Use convincing arguments to justify unfactorable polynomials.
 - Apply polynomial operations to problems involving perimeter and area.
- A5 Utilize various formulas in problem-solving situations.
- Evaluate and apply formulas (e.g., circumference, perimeter, area, volume, Pythagorean Theorem, interest, distance, rate, and time).
 - Reinforce formulas experimentally to verify solutions.

² *Mississippi mathematics framework—Algebra I*. (2003). Retrieved September 10, 2003, from http://marcopolo.mde.k12.ms.us/frameworks/mathematics/ma_algebra_i.html

- c. Given a literal equation, solve for any variable of degree one.
 - d. Using the appropriate formula, determine the length, midpoint, and slope of a segment in a coordinate plane.
 - e. Use formulas (e.g., point-slope and slope-intercept) to write equations of lines.
- A6 Communicate using the language of algebra.
- a. Recognize and demonstrate the appropriate use of terms, symbols, and notations.
 - b. Distinguish between linear and non-linear equations.
 - c. Translate between verbal expressions and algebraic expressions.
 - d. Apply the operations of addition, subtraction, and scalar multiplication to matrices.
 - e. Use scientific notation to solve problems.
 - f. Use appropriate algebraic language to justify solutions and processes used in solving problems.
- A7 Interpret and apply slope as a rate of change.
- a. Define slope as a rate of change using algebraic and geometric representations.
 - b. Interpret and apply slope as a rate of change in problem-solving situations.
 - c. Use ratio and proportion to solve problems including direct variation ($y=kx$).
 - d. Apply the concept of slope to parallel and perpendicular lines.
- A8 Analyze data and apply concepts of probability.
- a. Collect, organize, graph, and interpret data sets, draw conclusions, and make predictions from the analysis of data.
 - b. Define event and sample spaces and apply to simple probability problems.
 - c. Use counting techniques, permutations, and combinations to solve probability problems.

Biology I³

Competencies and Suggested Objective(s)

- B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
- a. Demonstrate the proper use and care for scientific equipment used in biology.
 - b. Observe and practice safe procedures in the classroom and laboratory.
 - c. Apply the components of scientific processes and methods in the classroom and laboratory investigations.
 - d. Communicate results of scientific investigations in oral, written, and graphic form.
- B2 Investigate the biochemical basis of life.
- a. Identify the characteristics of living things.
 - b. Describe and differentiate between covalent and ionic bonds using examples of each.
 - c. Describe the unique bonding and characteristics of water that makes it an essential component of living systems.

³ *Mississippi science framework—Biology I*. (2003). Retrieved September 10, 2003, from http://marcopolo.mde.k12.ms.us/frameworks/science/sci_biology_I.html

- d. Classify solutions using the pH scale and relate the importance of pH to organism survival.
 - e. Compare the structure, properties and functions of carbohydrates, lipids, proteins and nucleic acids in living organisms.
 - f. Explain how enzymes work and identify factors that can affect enzyme action.
- B3 Investigate cell structures, functions, and methods of reproduction.
- a. Differentiate between prokaryotic and eukaryotic cells.
 - b. Distinguish between plant and animal (eukaryotic) cell structures.
 - c. Identify and describe the structure and basic functions of the major eukaryotic organelles.
 - d. Describe the way in which cells are organized in multicellular organisms.
 - e. Relate cell membrane structure to its function in passive and active transport.
 - f. Describe the main events in the cell cycle and cell mitosis including differences in plant and animal cell divisions.
 - g. Relate the importance of meiosis to sexual reproduction and the maintenance of chromosome number.
 - h. Identify and distinguish among forms of asexual and sexual reproduction.
- B4 Investigate the transfer of energy from the sun to living systems.
- a. Describe the structure of ATP and its importance in life processes.
 - b. Examine, compare, and contrast the basic processes of photosynthesis and cellular respiration.
 - c. Compare and contrast aerobic and anaerobic respiration.
- B5 Investigate the principles, mechanisms, and methodology of classical and molecular genetics.
- a. Compare and contrast the molecular structures of DNA and RNA as they relate to replication, transcription, and translation.
 - b. Identify and illustrate how changes in DNA cause mutations and evaluate the significance of these changes.
 - c. Analyze the applications of DNA technology (forensics, medicine, agriculture).
 - d. Discuss the significant contributions of well-known scientists to the historical progression of classical and molecular genetics.
 - e. Apply genetic principles to solve simple inheritance problems including monohybrid crosses, sex linkage, multiple alleles, incomplete dominance, and codominance.
 - f. Examine inheritance patterns using current technology (gel electrophoresis, pedigrees, karyotypes).
- B6 Investigate concepts of natural selection as they relate to diversity of life.
- a. Analyze how organisms are classified into a hierarchy of groups and subgroups based on similarities and differences.
 - b. Identify characteristics of kingdoms including monerans, protists, fungi, plants and animals.
 - c. Differentiate among major divisions of the plant and animal kingdoms (vascular/non-vascular; vertebrate/invertebrate).
 - d. Compare the structures and functions of viruses and bacteria relating their impact on other living organisms.

- e. Identify evidence of change in species using fossils, DNA sequences, anatomical and physiological similarities, and embryology.
 - f. Analyze the results of natural selection in speciation, diversity, adaptation, behavior and extinction.
- B7 Investigate the interdependence and interactions that occur within an ecosystem.
- a. Analyze the flow of energy and matter through various cycles including carbon, oxygen, nitrogen and water cycles.
 - b. Interpret interactions among organisms in an ecosystem (producer/consumer/decomposer, predator/prey, symbiotic relationships and competitive relationships).
 - c. Compare variations, tolerances, and adaptations of plants and animals in major biomes.
 - d. Investigate and explain the transfer of energy in an ecosystem including food chains, food webs, and food pyramids.
 - e. Examine long and short-term changes to the environment as a result of natural events and human actions.

English II⁴

Competencies and Suggested Objective(s)

- E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
- a. Produce individual and/or group compositions and/or projects to persuade, tell a story, describe, create an effect, explain or justify an action or event, inform, entertain, etc.
 - b. Produce writing typically used in the workplace such as social, business, and technical correspondence; explanation of procedures; status reports; research findings; narratives for graphs; justification of decisions, actions, or expenses; etc.
 - c. Write a response, reaction, interpretation, analysis, summary, etc., of literature, other reading matter, or orally presented material.
 - d. Revise to ensure effective introductions, details, wording, topic sentences, and conclusions.
- E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
- a. Listen to determine the main idea and supporting details, to distinguish fact from opinion, and to determine a speaker's purpose or bias.
 - b. Speak with appropriate intonation, articulation, gestures, and facial expression.
 - c. Speak effectively to explain and justify ideas to peers, to inform, to summarize, to persuade, to entertain, to describe, etc.
- E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
- a. Read, view, and listen to distinguish fact from opinions and to recognize persuasive and manipulative techniques.

⁴ *Mississippi language arts framework—English II*. (2003). Retrieved September 10, 2003, from http://marcopolo.mde.k12.ms.us/frameworks/language_arts/la_10.html

- b. Access both print and non-print sources to produce an I-Search paper, research paper, or project.
 - c. Use computers and audio-visual technology to access and organize information for purposes such as resumes, career search projects, and analytical writings, etc.
 - d. Use reference sources, indices, electronic card catalog, and appropriate research procedures to gather and synthesize information.
- E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
- a. Interact with peers to examine real world and literary issues and ideas.
 - b. Show growth in critical thinking, leadership skills, consensus building, and self-confidence by assuming a role in a group, negotiating compromise, and reflecting on individual or group work.
- E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
- a. Share, critique, and evaluate works in progress and completed works through a process approach.
 - b. Communicate effectively in a group to present completed projects and/or compositions.
 - c. Edit oral and written presentations to reflect correct grammar, usage, and mechanics.
- E6 Explore cultural contributions to the history of the English language and its literature.
- a. Explore a variety of works from various historical periods, geographical locations, and cultures, recognizing their influence on language and literature.
 - b. Identify instances of dialectal differences which create stereotypes, perceptions, and identities.
 - c. Recognize root words, prefixes, suffixes, and cognates.
 - d. Relate how vocabulary and spelling have changed over time.
- E7 Discover the power and effect of language by reading and listening to selections from various literary genres.
- a. Listen to and read aloud selected works to recognize and respond to the rhythm and power of language to convey a message.
 - b. Read aloud with fluency and expression.
 - c. Analyze the stylistic devices, such as alliteration, assonance, word order, rhyme, onomatopoeia, etc., that make a passage achieve a certain effect.
 - d. Demonstrate how the use of language can confuse or inform, repel or persuade, or inspire or enrage.
 - e. Analyze how grammatical structure or style helps to create a certain effect.
- E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
- a. Read and explore increasingly complete works, both classic and contemporary, for oral discussion and written analysis.
 - b. Read, discuss, and interpret literature to make connections to life.
 - c. Read from a variety of genres to understand how the literary elements contribute to the overall quality of the work.

- d. Identify qualities in increasingly complex literature that have produced a lasting impact on society.
 - e. Read for enjoyment, appreciation, and comprehension of plot, style, vocabulary, etc.
- E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- a. Infuse the study of grammar and vocabulary into written and oral communication.
 - b. Demonstrate, in the context of their own writing, proficient use of the conventions of standard English, including, but not limited to, the following: complete sentences, subject-verb agreement, plurals, spellings, homophones, possessives, verb forms, punctuation, capitalization, pronouns, pronoun-antecedent agreement, parallel structure, and dangling and misplaced modifiers.
 - c. Give oral presentations to reinforce the use of standard English.
 - d. Employ increasingly proficient editing skills to identify and solve problems in grammar, usage, and structure.
- E10 Use language and critical thinking strategies to serve as tools for learning.
- a. Use language to facilitate continuous learning, to record observations, to clarify thought, to synthesize information, and to analyze and evaluate language.
 - b. Interpret visual material orally and in writing.

U. S. History from 1877⁵

Competencies and Suggested Objective(s)

- H1 Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.
- a. Apply economic concepts and reasoning when evaluating historical and contemporary social developments and issues (e.g., gold standard, free coinage of silver, tariff issue, laissez faire, deficit spending, etc.).
 - b. Explain the emergence of modern America from a domestic perspective (e.g., frontier experience, Industrial Revolution and organized labor, reform movements of Populism and Progressivism, Women’s Movement, Civil Rights Movement, the New Deal, etc.).
 - c. Explain the changing role of the United States in world affairs since 1877 through wars, conflicts, and foreign policy (e.g., Spanish-American War, Korean conflict, containment policy, etc.).
 - d. Trace the expansion of the United States and its acquisition of territory from 1877 (e.g., expansionism and imperialism).
- H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- a. Analyze the impact of inventions on the United States (e.g., telephone, light bulb, etc.).
 - b. Examine the continuing impact of the Industrial Revolution on the development of our nation (e.g., mass production, computer operations, etc.).

⁵ *Mississippi social studies framework—U.S. History from 1877*. (2003). Retrieved September 10, 2003, from http://marcopolo.mde.k12.ms.us/frameworks/social_studies/ss_us_history.html

- c. Describe the effects of transportation and communication advances since 1877.
- H3 Describe the relationship of people, places, and environments through time.
 - a. Analyze human migration patterns since 1877 (e.g., rural to urban, the Great Migration, etc.).
 - b. Analyze how changing human, physical, geographic characteristics can alter a regional landscape (e.g., urbanization, Dust Bowl, etc.).
- H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).
 - a. Interpret special purpose maps, primary/secondary sources, and political cartoons.
 - b. Analyze technological information on graphs, charts, and timelines.
 - c. Locate areas of international conflict (e.g., Caribbean, Southeast Asia, Europe, etc.).
- H5 Analyze the contributions of Americans to the ongoing democratic process to include civic responsibilities.
 - a. Examine various reform movements (e.g., Civil Rights, Women's Movement, etc.).
 - b. Examine the government's role in various movements (e.g., arbitration, 26th Amendment, etc.).
 - c. Examine the role of government in the preservation of citizens' rights (e.g., 19th Amendment, Civil Rights Act of 1964).
 - d. Examine individuals' duties and responsibilities in a democratic society (e.g., voting, volunteerism, etc.).

Appendix C: Workplace Skills for the 21st Century⁶

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

⁶ Secretary's commission on achieving necessary skills. Retrieved July 13, 2004, from <http://wdr.doleta.gov/SCANS/>

Appendix D: National Educational Technology Standards for Students⁷

- T1 Basic operations and concepts
- Students demonstrate a sound understanding of the nature and operation of technology systems.
 - Students are proficient in the use of technology.
- T2 Social, ethical, and human issues
- Students understand the ethical, cultural, and societal issues related to technology.
 - Students practice responsible use of technology systems, information, and software.
 - Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.
- T3 Technology productivity tools
- Students use technology tools to enhance learning, increase productivity, and promote creativity.
 - Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.
- T4 Technology communications tools
- Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
 - Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
- T5 Technology research tools
- Students use technology to locate, evaluate, and collect information from a variety of sources.
 - Students use technology tools to process data and report results.
 - Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.
- T6 Technology problem-solving and decision-making tools
- Students use technology resources for solving problems and making informed decisions.
 - Students employ technology in the development of strategies for solving problems in the real world.

⁷ ISTE: National educational technology standards (NETS). Retrieved July 13, 2004, from <http://cnets.iste.org/>