Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA100 - ORIENTATION
Unit Number: PA100

Dates: Spring 2016 **Hours:** 207.00

Last Edited By: Automotive Technology (05-12-2016)

Unit Description / Objectives:

Student will know and be able to demonstrate basic knowledge of safety practices including theory and practical laboratory organization, basic shop management including explaining and following all lab rules, and understand career opportunities available in the automotive industry.

Tasks:

PA - 101 Explain and follow all lab rules.

PA - 102 Participate in basic shop management.

PA - 103 Participate in parts ordering.

PA - 104 Demonstrate auto shop safety and hygiene.

PA - 105 Demonstrate the use of service information.

PA - 106 Demonstrate proper telephone courtesy.

PA - 107 Identify vehicle by: sight, V.I.N. and/or ID tag.

PA - 108 Identify career paths within the career and technical education program.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.

Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.

Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.

CRAFT & STRUCTURE GRADES 9-10-11-12
Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key terms, and other domain specific words.

Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.

Standard CC.3.5.9-10.F / Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure...and Analyze the structure of the relationships among concepts in a text.

INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).

Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.

Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.

INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12
Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.

Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.

Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.

RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Instructional Activities:

Knowledge:

Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
View and answer questions using interactive shopware video.
Understand and identify common chemicals using material worksheets (MSDS).
Participate in group discussions on safety concerns related to industry.
Fill out personal forms.
Prepare work stations and check for safety requirements.

List the most common automotive careers.
Describe the type of skills needed to be an auto technician.
Explain the tasks completed by each type of auto technician.
Summarize the ASE certification program.
Describe the different types of service manuals.
Find and use the service manual index and contents sections.
Explain the different kinds of information and illustrations used in a service manual.
Describe the three basic types of troubleshooting charts found in service manuals.
Explain how to use computer-based service information.
Correctly answer ASE certification test questions concerning service information.

Identify and locate the most important parts of a vehicle.
Describe the purpose of the fundamental automotive systems.
Explain the interaction of automotive systems.
Describe major automobile design variations.
Comprehend later lessons with a minimum amount of difficulty.
Correctly answer ASE certification test questions that require a knowledge of the major parts and systems of a vehicle.

Skill:

Complete assigned projects.
Shop Layout Poster.
Shop Safety Signs.
Inventory of large equipment.
Identify by sight vehicle VIN or ID.
Complete a parts ordering form.
Participate in parts ordering.
Identify career pathways for job specialties.
Interview a repair shop owner/operator.

Remediation:

Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:

Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.
Working on skills for SkillsUSA, Lehigh Valley Dealers Association, and/or Northampton Community College Competitions
Peer tutoring
Mentorship opportunities
ASE Practice tests
On-line Web Training

Special Adaptations:

Extended Time (assignments and/or testing)
Preferential Seating
Directions/Comprehension Check (frequent checks for understanding)
Study Guide
Directions and/or Tests Read Aloud
Adapted Tests and/or Assignments
Use of Calculator
Taking Tests in Alternate Setting (or if requested)
Verbal/Gestural Redirection (prompts to remain on task)

Drill and Practice (Repetition of Material)
Small Group Instruction
Provide Visual Model to Accompany Verbal Directions (Written/Oral Directions)
Use of Computer (Access to)
Positive Reinforcement
Have Student Repeat Directions
Wait Time
Access to School Counselor
Use of Highlighter/Highlighted Text
Provide Frequent Feedback
Provide Frequent Breaks
Regular Notebook Check
Variety of Assessment Methods
Highly Structured Classroom
Syllabus for Major Projects
Limited, Short Directions
Grading Rubric
Communication Regarding Behavior & Consequences (PBS)
Clear Language for Directions
Provide Opportunities to Retest
Frequent Review Sessions
Use a variety of Modalities when Introducing Skills/Concepts
Allow Oral Answers for Testing
Cue for Oral Response
De-Escalation Opportunities
Daily Classwork Check
Encourage Student to Check Work Before Turning In
Opportunities for Repeated Practice of MATH Skills
Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage
Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Student Must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards.
Know and follow the established safety rules at all times.

Safety:

Student Must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards and EPA regulations.
Know and follow the established safety rules at all times.

Assessment:

Written test
Oral activity test
Activity worksheets
Workbooks
Quizzes
Pre/Post Tests
Essays
Summaries
Time Cards
Writing Activities
Video/DVD Worksheets
Rubrics
Check Lists
Role-play Activities
Oral Presentation
Diagrams
Individual Projects
Group Projects
Research Papers
Current Events
Portfolio

Resources/Equipment:

Duffy, J.E. (2009).Module 1, Lesson 1 & 2: Foundations of Automotive Technology .Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Module 1, Lesson 1 & 2: Automotive Careers and Overview of Automotive Systems. Modern Automotive Service Technician (MAST) On-Line Training. (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Duffy, J.E. (2009). Textbook, Workbook and Student Job Manual - Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Snap-om Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions.
Assorted Parts Ordering Vendors
Monroe Career & Technical Institute: Material Safety Data Worksheets
Telephone
Safety Equipment
Cleaning Supplies
Shop Vehicles
Laptops and DesktopsHyperlinks:

www.g-wonlinetextbooks.com
www.sp2.org
www.library.alldatapro.com

Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA200 - SAFETY
Unit Number: PA200

Dates: Spring 2016 **Hours:** 84.00

Last Edited By: Automotive Technology (05-12-2016)

Unit Description / Objectives:

Student will know and be able to demonstrate basic knowledge of safety practices including theory and practical laboratory organization including all EPA and OSHA Regulations.

Tasks:

PA201 - Identify and follow all safety rules.

PA202 - Demonstrate the ability to secure vehicles on jack stands and hydraulic lifts.

PA203 - Demonstrate the ability to safely set-up/shut-down oxygen acetylene welding equipment.

PA204 - Identify chemical safety, "Right-To-Know Laws" and Safety Data Sheets (SDS).

PA205 - Identify and demonstrate the safe use of hand tools.

PA206 - Identify and demonstrate the safe use of power tools.

PA207 - Identify and demonstrate the safe use of protective clothing and equipment.

PA208 - Identify and demonstrate the safe use of fire protection equipment.

PA209 - Identify and demonstrate the safe use of shop equipment.

PA210 - Explain EPA and OSHA Regulations.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.

Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.

Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.

CRAFT & STRUCTURE GRADES 9-10-11-12
Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key terms, and other domain specific words.

Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.

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INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).

Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.

Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.

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Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.

Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.

Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.

RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.

Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

Instructional Activities:

Knowledge:

Identify common automotive hand tools.
List safety rules for hand tools.
Select the right tool for a given job.
Maintain and store tools properly.
Use hand tools safely.
Correctly answer ASE certification test questions referring to hand tools.

Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
View and answer questions using interactive shopware video.
Understand and identify common chemicals using material worksheets (MSDS).
Read MSDS Sheet.
Participate in group discussions on safety concerns related to industry.
Fill out personal forms.
Prepare work stations and check for safety requirements.

Describe the typical layout and sections of an auto shop.
List the types of accidents that can occur in an auto shop.
Explain how to prevent auto shop accidents.
Describe general safety rules for the auto shop.
Correctly answer ASE certification test questions referring to hand tools.

Identify common automotive hand tools.
List safety rules for hand tools.
List the most commonly used power tools and equipment.
Describe the uses for power tools and equipment.
Explain the advantages of one type of tool over another.
Explain safety rules that pertain to power tools and equipment.
Correctly answer ASE certification test questions that require a knowledge of power tools and equipment.

Define OSHA and its major functions.
Identify the hazardous waste produced from automobiles.
Define and illustrate common safety equipment used in the automobile service area.
Complete assigned project.
Create chart on hand tool.
Create chart on power tools.
List the safety rules used in the automobile service area.
Develop proper attitudes concerning safety in the automobile service area.
List the possible danger areas or common chemicals and accidents in the automobile service area.

Describe both customary and metric measuring systems.
Identify basic measuring tools.
Describe the use of common measuring tools.
Use conversion charts.
List safety rules relating to measurement.
Summarize basic math facts.
Correctly answer ASE certification test questions that require a basic understanding of measurement and math.

Use jack stands and jacks appropriately.
Use electric hydraulic lift appropriately.
Complete hand tool work stations activity.
Complete power tool work stations activity.
Complete activities on various shop large equipment.

Demonstrate safe use of tools during every activity.
Role playing activity related to MSDS.
Role playing activity related to fire safety procedures and clothing.
Practical activity on identifying unsafe tools.
Demonstrate ability to shut down hazardous chemical tanks.
Identify common automotive hand tools.
List safety rules for hand tools.
Select the right tool for a given job.
Maintain and store tools properly.
Use hand tools safely.

Skill:

Select the right tool for a given job.
Maintain and store tools properly.
Use hand tools safely.

Remediation:

Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:

Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.
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Special Adaptations:

Adaptations
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Have Student Repeat Directions
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Syllabus for Major Projects
Limited, Short Directions
Grading Rubric
Communication Regarding Behavior & Consequences (PBS)
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Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Safety:

Student Must:
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Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards and EPA regulations.
Know and follow the established safety rules at all times.

Assessment:

Written test
Oral activity test
Activity worksheets
Workbooks
Quizzes
Pre/Post Tests
Essays
Summaries
Log/Journal
Time Cards
Writing Activities
Video/DVD Worksheets

Rubrics
Check Lists
Role-play Activities
Debates
Oral Presentation
Diagrams
Individual Projects
Group Projects
Research Papers
Current Events
Portfolio

Resources/Equipment:

Duffy, J.E. (2009).Module 1, Lesson 3-6 Foundations of Automotive Technology .Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Module 1, Lesson 3-6: Foundations of Automotive Technology. Modern Automotive Service Technician (MAST) On-line Training. (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

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Snap-on Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions.
Monroe Career & Technical Institute, Safety Data Worksheet

National Automotive Technicians Education Foundation, Task Assessment Worksheet

Laptops and Desktop Computers

Exhaust Pipe
Ear Protectors
Safety Glasses
Respirator
Protective gloves
Firebox
Fire extinguisher
Waste Can
Eye Wash Station
Stationary
Mobile
Shop Uniform
Hyperlinks:

www.g-wonlinetextbooks.com

www.sp2.org

www.library.alldatapro.com

Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA300 - TOOLS/FASTENERS
Unit Number: PA300

Dates: Spring 2016 **Hours:** 130.00

Last Edited By: Automotive Technology (05-12-2016)

Description / Objectives:

Student will know and be able to demonstrate basic knowledge on the use of measuring, re-threading tools, and identifying fasteners according to industry standards.

Tasks:

PA301 - Identify and use fasteners and bolts.

PA302 - Demonstrate the ability to correctly drill and use re-threading tools.

PA303 - Demonstrate the ability to correctly read and interpret precision automotive measuring tools.

PA304 - Demonstrate the ability to correctly use automotive tools.

PA305 - Perform common fastener and thread repairs, to include: remove broken bolt, restore internal and external threads, and repair internal threads with a threaded insert.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
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Connecting Anchor/Standard:

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Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.

Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

Instructional Activities:

Knowledge:

Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
View and answer questions using interactive shopware video.
Understand and identify common chemicals using material worksheets (SDS).
Participate in group discussions on safety concerns related to industry.
Fill out personal forms.
Prepare work stations and check for safety requirements.
Identify commonly used automotive fasteners.
Summarize safety rules relating to fasteners, gaskets, seals, and sealants.
Correctly answer ASE certification test questions that require a knowledge of fasteners, gaskets, seals, and sealants.

Describe both customary and metric measuring systems.
Identify basic measuring tools.
Describe the use of common measuring tools.
Use conversion charts.
List safety rules relating to measurement.
Summarize basic math facts.
Correctly answer ASE certification test questions that require a basic understanding of measurement and math.

Skill:

Complete various work stations activities.
Select and use fasteners properly.
Remove, select, and install gaskets, seals, and sealants correctly.
Repair a variety of damaged threads and chase threads in a bore.
Measure cylinder oversize, taper, and out-of-round.
Hone cylinders.
Measure drum diameter.
Measure rotors with the appropriate micrometers.

Compare the gauge readings:
Oil Pressure Gauge test.
Compression Gauge test.
Vacuum Gauge test.
Cylinder Leakage Gauge test.
Fuel Pressure Gauge test.
Back Pressure Gauge test.
Gas Analyzer Gauge test.
Evap/smoke Pressure Gauge test.
Refrigerant Gauge test.
Temperature Gauge test.
Alternative Output Gauge test.
Starter motor Output Gauge test.
Power Steering Pressure Gauge test.
Tire Pressure Gauge test.
Cylinder Balance Gauge test.
Coolant System Pressure Gauge test.
Plastic Gauge bearing clearance test.
Feeler Gauge test.
Valve Spring height measurement test.
Cylinder head deck measurement.
Cylinder block deck surface measurement.
Piston ring to groove clearance measurement.
Brake rotor lateral run-out gauge measurement test.
Flywheel lateral run-out gauge measurement test.
End Play measurement gauge test.

Remediation:

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Research Papers
Current Events

Resources/Equipment:

Duffy, J.E. (2009).Module 1, Lesson 6 & 9: Foundations of Automotive Technology .Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Module 1, Lesson 6 & 9: Measurements and Math / Fasteners, Gaskets, Seals and Sealants. Modern Automotive Service Technician (MAST) On-Line Training. (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Duffy, J.E. (2009). Textbook, Workbook and Student Job Manual - Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Snap-om Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions.

Monroe Career & Technical Institute, Safety Data Worksheet

National Automotive Technicians Education Foundation, Task Assessment Worksheet

Laptops and Desktops

Safety equipment:
Safety glasses
Full Face Shields
Engines on Engine Stands
Engine Components on Workbenches
Complete Vehicle in shop bays
Fasteners from Fastenal Supplies

Tap and Die tool set
Dial Indicator Measuring Tool
Caliber Measuring Tool
Two Electric Reversible Drills
Micrometer Measuring Tool
Oil Pressure Gauge
Compression Gauge
Vacuum Gauge
Cylinder Leakage Gauge
Fuel Pressure Gauge
Back Pressure Gauge
Gas Analyzer Gauge
Evap/smoke Pressure Gauge
Refrigerant Gauge
Temperature Gauge
Battery Load Gauge
Alternative Output Gauge
Starter motor Output Gauge
Power Steering Pressure Gauge
Tire Pressure Gauge
Cylinder Balance Gauge
Coolant System Pressure Gauge
Plastic Gauge bearing clearance
Feeler Gauge
Valve Spring height measurement
Cylinder head deck measurement
Cylinder block deck surface measurement
Piston ring to groove clearance measurement
Brake rotor lateral run-out gauge measurement
Flywheel lateral run-out gauge measurement
End Play measurement gauge
Hyperlinks:
www.g-wonlinetextbooks.com
www.sp2.org
www.library.alldatapro.com

Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA400 - CERTIFICATIONS
Unit Number: PA400

Dates: Spring 2016 **Hours:** 70.00

Last Edited By: Automotive Technology (05-12-2016)

Unit Description / Objectives:

Student will know and be able to identify the regulations on Safety Inspections, Emission Inspections, Hazardous Material, Refrigerant Recovery, handling and Recycling of Refrigerant and also to be able to obtain these certifications.

Tasks:

PA401 - Prepare to obtain PA Safety Inspection Certification.

PA402 - Prepare to obtain EPA 609 Refrigerant Recovery, Recycling Certification.

PA403 - Prepare to obtain Emission Inspection Certification.

L404 - Safety Pollution / SP2

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.

Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.

Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.

CRAFT & STRUCTURE GRADES 9-10-11-12
Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key terms, and other domain specific words.

Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.

Standard CC.3.5.9-10.F / Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure...and Analyze the structure of the relationships among concepts in a text.

INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).

Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.

Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.

INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12
Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.

Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.

Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.

RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Focus Anchor/Standard #2:

- Pennsylvania Core Standards for Writing for Technical Subjects Standard 3.6

Supporting Anchor/Standards:

TEXT TYPES AND PURPOSE GRADES 9-10-11-12
Standard CC.3.6.9-10.A Standard CC.3.6.11-12.A Write arguments focused on discipline specific content.

Standard CC.3.6.9-10.B Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes, etc.

PRODUCTION & DISTRIBUTION OF WRITING GRADES 9-10-11-12
Standard CC.3.6.9-10.C Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience.

Standard CC.3.6.9-10 D Standard CC.3.6.11-12.D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

Standard CC.3.6.9-10.E Standard CC.3.6.11-12.E. Use technology, including the internet, to produce, publish, and update individual or shared writing products.

RESEARCH GRADES 9-10-11-12
Standard CC.3.6.9-10.F Standard CC.3.6.11-12.F Conduct short and more sustained research to answer a question or solve a problem.

Standard CC.3.6.9-10.G. Standard CC.3.6.11-12.G Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation.

Standard CC.3.6.9-10.H. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.

RANGE OF WRITING GRADES 9-10-11-12
Standard CC.3.5.9-10.I & Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences...etc.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.

Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

ALGEBRA
Standard 2.2.HS.C.9 Prove the Pythagorean identity and use it to calculate trigonometric ratios.

Instructional Activities:

Knowledge:
Participate in lecture and discussion and respond to questions
Complete reading assignments
Complete written assignments
Participate with the group activities
Review PA State Guidelines for Passing a Vehicle for State Inspection
Complete documentation paperwork for PA State Inspection
Complete SP/2 on-line course on Handling of Refrigerants

Skill:
Complete Task Sheet Assignment
Perform measurements, checks, and visual inspections on the safety components required by the PA State requirements
Determine if the emissions devices are present on the vehicle and in good working condition
Perform Visual Inspection of Vehicle
Perform Inspection Breakdown:
Brake Systems Inspection
Brake System Measurements
Tire System Inspection
Tire System Measurement
Steering System Inspection
Steering System Measurement
Suspension System Inspection
Suspension System Measurements

Remediation:
Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:

Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.

Working on skills for Skills-USA, Lehigh Valley Dealers Association, and/or Northampton Community College competitions

Special Adaptations:

Extended Time (assignments and/or testing)
Preferential Seating
Directions/Comprehension Check (frequent checks for understanding)
Study Guide
Directions and/or Tests Read Aloud
Adapted Tests and/or Assignments
Use of Calculator
Taking Tests in Alternate Setting (or if requested)
Verbal/Gestural Redirection (prompts to remain on task)
Drill and Practice (Repetition of Material)
Small Group Instruction
Provide Visual Model to Accompany Verbal Directions (Written/Oral Directions)
Use of Computer (Access to)
Positive Reinforcement
Have Student Repeat Directions
Wait Time
Access to School Counselor
Use of Highlighter/Highlighted Text
Provide Frequent Feedback
Provide Frequent Breaks
Regular Notebook Check
Variety of Assessment Methods
Highly Structured Classroom
Syllabus for Major Projects
Limited, Short Directions
Grading Rubric
Communication Regarding Behavior & Consequences (PBS)
Clear Language for Directions
Provide Opportunities to Retest
Frequent Review Sessions
Use a variety of Modalities when Introducing Skills/Concepts
Allow Oral Answers for Testing
Cue for Oral Response
De-Escalation Opportunities
Daily Classwork Check
Encourage Student to Check Work Before Turning In
Opportunities for Repeated Practice of MATH Skills
Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage
Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Safety:

Student must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards.
Know and follow the established safety rules at all times.

Assessment:

Written test
Oral activity test
Activity worksheets
Workbooks
Quizzes
Pre/Post Tests
Essays
Summaries
Log/Journal
Time Cards
Writing Activities
Video/DVD Worksheets
Rubrics
Check Lists
Role-play Activities
Debates
Oral Presentation
Diagrams
Individual Project
Research Papers
Current Events
Portfolio

Resources/Equipment:

Common hand tools:
Wrenches--open end, box end, and combination
Sockets--shallow, deep, 6-point, 12-point, standard, and impact
Drive size--1/4 inch, 3/8 inch, 1/2 inch, and 3/4 inch
Socket accessories--speed handle, extensions 3 to 36 inches long, universals, flex handle, and T bar
Screwdrivers--flat blade (standard), Phillips, clutch, and Torx
Pliers--slip joint, water pump, diagonal cutting, vise grip, snap ring, needle nose, battery, and duck bill

Punches--taper, pin, and center
Hammers--ball peen, soft face, and brass
Fluke Digital Volt Ohm Meter
Oscilloscope – Snap-On Vantage Meter
Hunter Digital Alignment Machi
Deluxe Snap-On Back Pressure Gauge Kit
Coolant Pressure Test Kit
Electronic Stethoscope
Fuel Pressure Line Disconnect Kit
Brake Flaring Tool Kit
Micrometer Measuring Tool
Caliber Measuring Tool
Dial Indicator Measuring Tool
Above the ground vehicle lifts
Drive-On lifts with hydraulic jacks
Tripod Jack Stands
Screw Jack Stand
Standard Jack Stand
Four 2 ½ ton Floor Jacks
Torque Wrenches: 3/8 – ½ inch Drive
Inch Pound Torque Wrench
Stationary AAMCO Brake Lathe
Hunter On-Vehicle Brake Lathe
Hyperlinks:
www.g-wonlinetextbooks.com
www.sp2.org
www.library.alldatapro.com

Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA500 - SUSPENSION AND STEERING

Unit Number: PA500

Dates: Spring 2016 **Hours:** 187.00

Last Edited By: Automotive Technology (05-12-2016)

Description / Objectives:

Student will know and be able to identify components and diagnosis and demonstrate basic knowledge of tires, wheels, steering and suspension systems to industry standards.

Tasks:

PA501 - Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

PA502 - Identify and interpret suspension and steering system concerns; determine necessary action.

PA503 - Research applicable vehicle and service information, such as suspension and steering system operation, vehicle service history, service precautions, and technical service bulletins.

PA504 - Locate and interpret vehicle and major component identification numbers.

PA505 - Disable and enable supplemental restraint system (SRS).

PA506 - Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).

PA507 - Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets.

PA508 - Inspect and replace rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.

PA509 - Determine proper power steering fluid type; inspect fluid level and condition.

PA510 - Flush, fill, and bleed power steering system.

PA511 - Diagnose power steering fluid leakage; determine necessary action.

PA512 - Remove, inspect, replace, and adjust power steering pump belt.

PA513 - Remove and reinstall power steering pump.

PA514 - Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment.

PA515 - Inspect and replace power steering hoses and fittings.

PA516 - Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.

PA517 - Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.

PA518 - Inspect and test electric power assist steering.

PA519 - Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.

PA520 - Remove, inspect and install strut rods and bushings.

PA521 - Remove, inspect, and install upper and/or lower ball joints.

PA522 - Remove, inspect, and install steering knuckle assemblies.

PA523 - Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.

PA524 - Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.

PA525 - Remove, inspect, and install stabilizer bar bushings, brackets, and links.

PA526 - Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.

PA527 - Inspect, remove, and replace shock absorbers.

PA528 - Remove, inspect, and service or replace front and rear wheel bearings.

PA529 - Lubricate suspension and steering systems.

PA530 - Perform pre-alignment inspection and measure vehicle ride height; perform necessary action.

PA531 - Prepare vehicle for wheel alignment on the alignment machine; perform four wheel alignment by checking and adjusting front and rear wheel caster, camber; and toe as required; center steering wheel.

PA532 - Check SAI (steering axis inclination) and included angle; determine necessary action.

PA533 - Check rear wheel thrust angle; determine necessary action.

PA534 - Check for front wheel setback; determine necessary action.

PA535 - Check front and/or rear cradle (subframe) alignment; determine necessary action.

PA536 - Inspect tire condition; identify tire wear patterns; check and adjust air pressure; determine necessary action.

PA537 - Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.

PA538 - Rotate tires according to manufacturer’s recommendations.

PA539 - Measure wheel, tire, axle flange, and hub runout; determine necessary action.

PA540 - Diagnose tire pull problems; determine necessary action.

PA541 - Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic).

PA542 - Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.

PA543 - RESERVED

PA544 - Inspect tire and wheel assembly for air loss; perform necessary action.

PA545 - Repair tire using internal patch.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.

Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.

Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.

CRAFT & STRUCTURE GRADES 9-10-11-12
Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key terms, and other domain specific words.

Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.

Standard CC.3.5.9-10.F / Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure...and Analyze the structure of the relationships among concepts in a text.

INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).

Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.

Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.

INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12
Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.

Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.

Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.

RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Focus Anchor/Standard #2:

- Pennsylvania Core Standards for Writing for Technical Subjects Standard 3.6

Supporting Anchor/Standards:

TEXT TYPES AND PURPOSE GRADES 9-10-11-12
Standard CC.3.6.9-10.A Standard CC.3.6.11-12.A Write arguments focused on discipline specific content.

Standard CC.3.6.9-10.B Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes, etc.

PRODUCTION & DISTRIBUTION OF WRITING GRADES 9-10-11-12
Standard CC.3.6.9-10.C Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience.

Standard CC.3.6.9-10 D Standard CC.3.6.11-12.D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

Standard CC.3.6.9-10.E Standard CC.3.6.11-12.E. Use technology, including the internet, to produce, publish, and update individual or shared writing products.

RESEARCH GRADES 9-10-11-12
Standard CC.3.6.9-10.F Standard CC.3.6.11-12.F Conduct short and more sustained research to answer a question or solve a problem.

Standard CC.3.6.9-10.G. Standard CC.3.6.11-12.G Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation.

Standard CC.3.6.9-10.H. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.

RANGE OF WRITING GRADES 9-10-11-12
Standard CC.3.5.9-10.I & Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences...etc.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.

Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

ALGEBRA
Standard 2.2.HS.C.9 Prove the Pythagorean identity and use it to calculate trigonometric ratios.

Instructional Activities:

Knowledge:

Identify the parts of a tire and wheel.
Describe different methods of tire construction.
Explain tire and wheel sizes.
Describe tire ratings.
Identify the parts of driving and nondriving hub and wheel bearing assemblies

Correctly answer ASE certification test questions requiring a knowledge of tires, wheels, hubs, and wheel bearings.
Diagnose common tire, wheel, and wheel bearing problems. Describe tire inflation and rotation procedures.
Measure tire and wheel runout.
Explain static and dynamic wheel balance.
Summarize different methods of balancing wheels and tires.
Explain service procedures for wheel bearings.
Use safe practices while servicing tires and wheels.
Correctly answer ASE certification test questions requiring knowledge of the service and repair of tires, wheels, and wheel bearings.
Identify the major parts of a suspension system.
Describe the basic function of each suspension system component.
Explain the operation of the four common types of springs.
Compare the various types of suspension systems.
Explain automatic suspension leveling systems.
Correctly answer ASE certification test questions requiring a knowledge of suspension system construction and design.

Skill:

Diagnose problems relating to a suspension system.
Replace shock absorbers and ball joints.
Describe the removal and replacement of springs.
Service a strut assembly.
Replace control arm bushings.
Use safe work procedures while repairing suspension systems.
Diagnose and repair electronically-controlled suspension systems.
Correctly answer ASE certification test questions about the
diagnosis and repair of Identify the major parts of a steering system.
Explain the operating principles of steering systems.
Compare the differences between a linkage steering and a racking pinion steering system.
Describe the operation of hydraulic and electric-assist power steering systems.
Explain the operation of four-wheel steering systems.
Correctly answer ASE certification test questions requiring knowledge of modern steering and suspension system designs.
Describe common steering system problems.
Properly inspect and determine the condition of a steering system.
Explain basic steering column repair operations.
Adjust both worm gears and rack-and-pinion gears.
Describe service and repair procedures for a rack-and-pinion steering gear.
Service power steering belts, hoses, and fluid.
Explain how to complete basic power steering tests.
Use safe work procedures.
Correctly answer ASE certification test questions about the diagnosis and repair of today's steering systems.
Explain the principles of wheel alignment.
List the purpose of each wheel alignment setting.
Perform a prealignment inspection of tires, steering, and suspension systems.
Describe caster, camber, and toe adjustment.
Explain toe-out on turns, steering axis inclination, and tracking.

Describe the use of different types of wheel alignment equipment.
Correctly answer ASE certification test questions requiring a knowledge of wheel alignment angles and procedures.
Explain how vehicle body and frame construction works with restraint systems to protect a vehicle's occupants.
Identify and locate the most important parts of vehicle restraint systems.
Describe the purpose of restraint systems.
Describe restraint system design variations.
Summarize the operation of restraint system sensors, inflator modules, and electronic control modules.

Correctly answer ASE certification test questions requiring a knowledge of restraint system operation and construction.
Explain how to inspect and repair seat belts.
Summarize how to scan restraint systems for problems.
Describe safety rules for working with air bags.
Summarize the procedure for air bag replacement.
Explain how to replace air bag sensors.
Describe how to service an air bag controller.
Correctly answer ASE certification test questions about the diagnosis and repair of restraint systems.

A. General Suspension and Steering Systems Diagnosis
   1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
   2. Identify and interpret suspension and steering system concerns; determine necessary action.
   3. Research applicable vehicle and service information, such as suspension and steering system operation, vehicle service history, service precautions, and technical service bulletins.
   4. Locate and interpret vehicle and major component identification numbers.

B. Steering Systems Diagnosis and Repair
   1. Disable and enable supplemental restraint system (SRS).
   2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).
   3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.
   4. Diagnose power steering gear (non-rack and-pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action.
   5. Diagnose power steering gear (rack-and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action. P-2
   6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action. P-2
   7. Adjust non-rack-and-pinion worm bearing preload and sector lash. P-3
   8. Remove and replace rack-and-pinion steering gear; inspect mounting bushings and brackets. P-2
   9. Inspect and replace rack-and-pinion steering gear inner tie rod ends (sockets) and bellows boots. P-2
   10. Determine proper power steering fluid type; inspect fluid level and condition. P-1
   11. Flush, fill, and bleed power steering system. P-2
   12. Diagnose power steering fluid leakage; determine necessary action. P-2
   13. Remove, inspect, replace, and adjust power steering pump belt. P-1
   14. Remove and reinstall power steering pump. P-2
   15. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment. P-2
   16. Inspect and replace power steering hoses and fittings. P-2
   17. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper. P-2

18. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps. P-1
19. Test and diagnose components of electronically controlled steering systems using a scan tool; determine necessary action. P-3
20. Inspect and test electric power assist steering. P-3, A4 Suspension and Steering NATEF Competency Checklist page 3
21. Identify hybrid vehicle power steering system electrical circuits, service and safety precautions. P-3

C. Suspension Systems Diagnosis and Repair
1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action. P-1
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action. P-1
3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers. P-2
4. Remove, inspect, and install strut rods and bushings. P-2
5. Remove, inspect, and install upper and/or lower ball joints. P-1
6. Remove, inspect, and install steering knuckle assemblies. P-2
7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators. P-3
8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts. P-3
9. Remove, inspect, and install stabilizer bar bushings, brackets, and links. P-2
10. Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount. P-1
11. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts. P-3

D. Related Suspension and Steering Service
1. Inspect, remove, and replace shock absorbers. P-1
2. Remove, inspect, and service or replace front and rear wheel bearings. P-1
3. Test and diagnose components of electronically controlled suspension systems using a scan tool; determine necessary action. P-3, A4 Suspension and Steering NATEF
4. Diagnose, inspect, adjust, repair or replace components of electronically controlled steering systems (including sensors, switches, and actuators); initialize system as required. P-3
5. Describe the function of the idle speed compensation switch. P-3
6. Lubricate suspension and steering systems. P-2

E. Wheel Alignment Diagnosis, Adjustment, and Repair
1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action. P-1
2. Perform prealignment inspection and measure vehicle ride height; perform necessary action. P-1.
3. Prepare vehicle for wheel alignment on the alignment machine; perform four wheel alignment by checking and adjusting front and rear wheel caster, camber; and toe as required; center steering wheel. P-1.
4. Check toe-out-on-turns (turning radius); determine necessary action. P-2.
5. Check SAI (steering axis inclination) and included angle; determine necessary action. P-2.
6. Check rear wheel thrust angle; determine necessary action. P-1.
7. Check for front wheel setback; determine necessary action. P-2.
8. Check front and/or rear cradle (subframe) alignment; determine necessary action. P-3.

F. Wheel and Tire Diagnosis and Repair
1. Inspect tire condition; identify tire wear patterns; check and adjust air pressure; determine necessary action. P-1.
2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action. P-2.
3. Rotate tires according to manufacturer's recommendations. P-1.
4. Measure wheel, tire, axle flange, and hub runout; determine necessary action. P-2.
5. Diagnose tire pull problems; determine necessary action. P-2. A4 Suspension and Steering NATEF Competency.

6. Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic). P-1.
7. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor. P-2.
8. Reinstall wheel; torque lug nuts. P-1.
9. Inspect tire and wheel assembly for air loss; perform necessary action. P-1.
10. Repair tire using internal patch. P-1.
11. Inspect, diagnose, and calibrate tire pressure monitoring system. P-2.

Remediation:

Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:

Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.
Working on skills for SkillsUSA, Lehigh Valley Dealers Association, and/or Northampton Community College competitions

Special Adaptations:

Extended Time (assignments and/or testing)
Preferential Seating
Directions/Comprehension Check (frequent checks for understanding)
Study Guide
Directions and/or Tests Read Aloud
Adapted Tests and/or Assignments
Use of Calculator
Taking Tests in Alternate Setting (or if requested)
Verbal/Gestural Redirection (prompts to remain on task)
Drill and Practice (Repetition of Material)
Small Group Instruction
Provide Visual Model to Accompany Verbal Directions (Written/Oral Directions)
Use of Computer (Access to)
Positive Reinforcement
Have Student Repeat Directions
Wait Time
Access to School Counselor
Use of Highlighter/Highlighted Text
Provide Frequent Feedback
Provide Frequent Breaks
Regular Notebook Check
Variety of Assessment Methods
Highly Structured Classroom
Syllabus for Major Projects
Limited, Short Directions
Grading Rubric
Communication Regarding Behavior & Consequences (PBS)
Clear Language for Directions
Provide Opportunities to Retest
Frequent Review Sessions

Use a variety of Modalities when Introducing Skills/Concepts
Allow Oral Answers for Testing
Cue for Oral Response
De-Escalation Opportunities
Daily Classwork Check
Encourage Student to Check Work Before Turning In
Opportunities for Repeated Practice of MATH Skills
Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage
Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Safety:

Student Must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards and EPA regulations.
Know and follow the established safety rules at all times.

Assessment:

Written test
Oral activity test
Activity worksheets
Workbooks
Quizzes
Pre/Post Tests
Essays
Summaries
Log/Journal
Time Cards
Writing Activities
Video/DVD Worksheets
Rubrics
Check Lists
Debates
Oral Presentation
Diagrams
Individual Projects
Group Projects
Research Papers
Current Events
Portfolio

Resources/Equipment:

Duffy, J.E.(2009).Module 7, Lesson 1-7: Suspension and Steering: Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Module 7, Lesson 1-7: Suspension System Fundamentals. Modern Automotive Service Technician (MAST) on-line Training. (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Duffy, J.E. (2009). Textbook, Workbook and Student Job Manual - Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodheart-Willcox Company, Inc.

Snap-om Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions.

Monroe Career & Technical Institute, Material Safety Data Worksheet

National Automotive Technicians Education Foundation, Task Assessment Worksheet

Laptops and Desktops

Safety equipment:
Safety glasses
Full Face Shields
Engine Components on Workbenches
Complete Vehicle in shop bays
Fasteners from Fastenal Supplies
Tap and Die tool set
Dial Indicator Measuring Tool
Caliber Measuring Tool
Two Electric Reversible Drills
Micrometer Measuring T
Power Steering Pressure Gauge
Tire Pressure Gauge
Feeler Gauge
End Play measurement gauge

Hyperlinks:
www.g-wonlinetextbooks.com

www.sp2.org

www.library.alldatapro.com

Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA600 - BRAKES
Unit Number: PA600

Dates: Spring 2016 **Hours:** 158.00

Last Edited By: Automotive Technology (05-12-2016)

Unit Description / Objectives:

Student will know and be able to check, test, evaluate, diagnose, analyze, service, repair, replace, and interpret all components of the general brake system, electronic brake control system and the traction control system.

Tasks:

PA601 - Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

PA602 - Identify and interpret brake system concern; determine necessary action.

PA603 - Research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions, and technical service bulletins.

PA604 - Locate and interpret vehicle and major component identification numbers.

PA605 - Measure brake pedal height, travel, and free play (as applicable); determine necessary action.

PA606 - Check master cylinder for internal/external leaks and proper operation; determine necessary action.

PA607 - Remove, bench bleed, and reinstall master cylinder.

PA608 - Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.

PA609 - Replace brake lines, hoses, fittings, and supports.

PA610 - Fabricate brake lines using proper material and flaring procedures (double flare and ISO types).

PA611 - Select, handle, store, and fill brake fluids to proper level.

PA612 - Inspect, test, and/or replace components of brake warning light system.

PA613 - Bleed and/or flush brake system.

PA614 - Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.

PA615 - Remove, clean, inspect, and measure brake drums; determine necessary action.

PA616 - Refinish brake drum; measure final drum diameter.

PA617 - Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/ self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.

PA618 - Inspect and install wheel cylinders.

PA619 - Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings.

PA620 - Install wheel, torque lug nuts, and make final checks and adjustments.

PA621 - RESERVED

PA622 - Remove caliper assembly; inspect for leaks and damage to caliper housing; determine necessary action.

PA623 - Clean and inspect caliper mounting and slides/pins for operation, wear, and damage; determine necessary action.

PA624 - Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks.

PA625 - Clean, inspect, and measure rotor thickness, lateral runout, and thickness variation; determine necessary action.

PA626 - Remove and reinstall rotor.

PA627 - Refinish rotor on vehicle; measure final rotor thickness.

PA628 - Refinish rotor off vehicle; measure final rotor thickness.

PA629 - Install wheel, torque lug nuts, and make final checks and adjustments.

PA630 - Check brake pad wear indicator system operation; determine necessary action.

PA631 - Test pedal free travel; check power assist operation.

PA632 - Check vacuum supply to vacuum-type power booster.

PA633 - Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub

and adjust bearings.

PA634 - Check parking brake cables and components for wear, binding, and corrosion; clean, lubricate, adjust or replace as needed.

PA635 - Check parking brake and indicator light system operation; determine necessary action.

PA636 - Check operation of brake stop light system; determine necessary action.

PA637 - Replace wheel bearing and race.

PA638 - Inspect and replace wheel studs.

PA639 - Remove and reinstall sealed wheel bearing assembly.

PA640 - Identify and inspect electronic brake control system components; determine necessary action.

PA641 - Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine necessary action.

PA642 - Depressurize high-pressure components of the electronic brake control system.

PA643 - Bleed the electronic brake control system hydraulic circuits.

PA644 - Identify traction control/vehicle stability control system components.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.

Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.

Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.

CRAFT & STRUCTURE GRADES 9-10-11-12
Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key terms, and other domain specific words.

Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.

Standard CC.3.5.9-10.F / Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure...and Analyze the structure of the relationships among concepts in a text.

INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).

Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.

Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.

INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12
Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.

Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.

Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.

RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Focus Anchor/Standard #2:

- Pennsylvania Core Standards for Writing for Technical Subjects Standard 3.6

Supporting Anchor/Standards:

TEXT TYPES AND PURPOSE GRADES 9-10-11-12
Standard CC.3.6.9-10.A Standard CC.3.6.11-12.A Write arguments focused on discipline specific content.

Standard CC.3.6.9-10.B Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes, etc.

PRODUCTION & DISTRIBUTION OF WRITING GRADES 9-10-11-12

Standard CC.3.6.9-10.C Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience.

Standard CC.3.6.9-10 D Standard CC.3.6.11-12.D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

Standard CC.3.6.9-10.E Standard CC.3.6.11-12.E. Use technology, including the internet, to produce, publish, and update individual or shared writing products.

RESEARCH GRADES 9-10-11-12
Standard CC.3.6.9-10.F Standard CC.3.6.11-12.F Conduct short and more sustained research to answer a question or solve a problem.

Standard CC.3.6.9-10.G. Standard CC.3.6.11-12.G Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation.

Standard CC.3.6.9-10.H. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.

RANGE OF WRITING GRADES 9-10-11-12
Standard CC.3.5.9-10.I & Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences...etc.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.

Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

GEOMETRY
Standard 2.3.HS.A.7 Apply trigonometric ratios to solve problems involving right triangles.
Standard 2.3.HS.A.3 Verify and apply geometric theorems as they relate to geometric figures.
Standard 2.3.HS.A.13 Analyze relationships between two dimensional and three dimensional objects.

Instructional Activities:

Knowledge:

Explain the hydraulic and mechanical principles of a brake system.
Identify the major parts of an automotive brake system.
Define the basic functions of the major parts of a brake system.
Compare drum and disc brakes.
Describe the operation of parking brakes.
Explain the operation of power brakes.
Correctly answer ASE certification test questions requiring a knowledge of automotive brake systems.
Identify the major parts of a typical anti-lock brake system.
Describe the operation of anti-lock brake systems.
Compare anti-lock brake design variations.
Diagnose problems in anti-lock brake systems.
Repair anti-lock brake systems.
Describe the purpose and operation of traction control and stability control systems.
Diagnose and repair traction control and stability control systems.
Correctly answer ASE certification test questions requiring a knowledge of anti-lock brake systems, traction control systems, and stability control systems.

Describe basic procedures for servicing a master cylinder and a brake booster.
Explain how to service a disc brake assembly.
Explain how to service a drum brake assembly.
Describe the procedures for both manual and pressure bleeding of a brake system.
Cite the safety rules that should be followed when servicing brake systems.
Correctly answer ASE certification test questions about the diagnosis and repair of brake systems.

Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
Identify and interpreter brake system concern and determine necessary action.
Compute using Pascal's Law.

Skill:

V. BRAKES

A. General Brake Systems Diagnosis
   11. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 94–95
   12. Identify and interpret brake system concern; determine necessary action. P-1 1394–1398, 1421
   13. Research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions, and technical service bulletins. P-1 85–95
   14. Locate and interpret vehicle and major component identification numbers. P-1 86, 87

B. Hydraulic System Diagnosis and Repair
   11. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law). P-1 1371, 1372
   12. Measure brake pedal height, travel, and free play (as applicable); determine necessary action. P-1 1396
   13. Check master cylinder for internal/external leaks and proper operation; determine necessary action. P-1 133, 1395–1397
   14. Remove, bench bleed, and reinstall master cylinder. P-1 1400, 1401
   15. Diagnose poor stopping, pulling or dragging concerns caused by malfunctions in the hydraulic system; determine necessary action. P-2 1394–1396
   16. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action. P-1 1396, 1397, 1403
   17. Replace brake lines, hoses, fittings, and supports. P-2 1403
   18. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types). P-2 1403
   19. NATEF Task List Correlation Chart 45, Task Number and Description Priority Page #s
   20. Select, handle, store, and fill brake fluids to proper level. P-1 1378, 1397
   21. Inspect, test, and/or replace metering (hold-off), proportioning (balance), pressure differential, and combination valves. P-3 1387, 1388, 1395
   11. Inspect, test, and/or replace components of brake warning light system. P-3 1386, 1387
   22. Bleed and/or flush brake system. P-1 1401–1403
   23. Test brake fluid for contamination. P-1 1397

C. Drum Brake Diagnosis and Repair
   11. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action. P-1 1394–1396
   12. Remove, clean, inspect, and measure brake drums; determine necessary action. P-1 1410, 1411, 1414–1416
   13. Refinish brake drum; measure final drum diameter. P-1 1413, 1414

13. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble. P-1 1410, 1411, 1414–1416
14. Inspect and install wheel cylinders. P-2 1410–1413
15. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings. P-2 1416
16. Install wheel, torque lug nuts, and make final checks and adjustments. P-1 1260, 1261

D. Disc Brake Diagnosis and Repair

11. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pulsation concerns; determine necessary action. P-1 1394–1395
12. Remove caliper assembly; inspect for leaks and damage to caliper housing; determine necessary action. P-1 1403–1405
13. Clean and inspect caliper mounting and slides/pins for operation, wear, and damage; determine necessary action. P-1 1404
14. Remove, inspect and replace pads and retaining hardware; determine necessary action. P-1 1404
15. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts. P-3 1405
16. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks. P-1 1405, 1408
17. Clean, inspect, and measure rotor thickness, lateral run-out, and thickness variation; determine necessary action P-1 1405–1408
18. Remove and reinstall rotor. P-1 1268–1272
19. Refinish rotor on vehicle; measure final rotor thickness. P-1 1406–1407
20. Refinish rotor off vehicle; measure final rotor thickness. P-1 1406–1407
21. Retract caliper piston on an integrated parking brake system. P-3 1388, 1416
22. Install wheel, torque lug nuts, and make final checks and adjustments. P-1 1260, 1261

E. Power Assist Units Diagnosis and Repair

11. Test pedal free travel; check power assist operation. P-2 1396, 1399
12. Check vacuum supply to vacuum-type power booster. P-1 1398, 1399
13. Inspect the vacuum-type power booster unit for leaks; inspect the check valve for proper operation; determine necessary action. P-1 1398, 1399
14. Inspect and test hydraulically assisted power brake system for leaks and proper operation; determine necessary action. P-3 1399
15. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair
16. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action. P-1 1259, 1260, 1394, 1395
17. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust bearings. P-1 1268–1273
18. Check parking brake cables and components for wear, binding, and corrosion; clean, lubricate, adjust or replace as needed. P-2 1393, 1398, 1416, 1417
19. Check parking brake and indicator light system operation; determine necessary action. P-1 1397, 1398
20. Check operation of brake stop light system; determine necessary action. P-1 639–640, 644
21. Replace wheel bearing and race. P-2 1268–1273
22. Inspect and replace wheel studs. P-1 1261–1262
23. Remove and reinstall sealed wheel bearing assembly. P-1 1268–1273

F. Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair

11. Identify and inspect electronic brake control system components; determine necessary action. P-1 1422–1440
12. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine necessary action. P-2 1444

13. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine necessary action. P-1 1433–1439
14. Depressurize high-pressure components of the electronic brake control system. P-3 1433
15. Bleed the electronic brake control system hydraulic circuits. P-1 1433
16. Remove and install electronic brake control system electrical/ electronic and hydraulic components. P-3 1434–1439
17. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data). P-1 1434–1439
18. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.). P-3 1433
19. Identify traction control/vehicle stability control system components. P-3 1430–1433, 1439–1441
20. Describe the operation of a regenerative braking system.

Remediation:

Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:

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Working on skills for SkillsUSA, Lehigh Valley Dealers Association, and/or Northampton Community College competitions

Special Adaptations:

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Cue for Oral Response
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Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage
Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Safety:

Student must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards.
Know and follow the established safety rules at all times.

Assessment:

Written test
Activity worksheets
Workbooks
Quizzes
Pre/Post Tests
Essays
Summaries
Time Cards
Writing Activities
Video/DVD Worksheets
Rubrics
Check List
Oral Presentation
Diagrams
Individual Projects
Group Projects
Research Papers
Current Events

Resources/Equipment:

Duffy, J.E. (2009).Module 1, Lesson 2: Automotive Careers and Required Skills. 22-33.Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodheart-Willcox Company, Inc.

Module 7, Lesson 8: Brake System Fundamentals, Modern Automotive Service Technician (MAST). (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Duffy, J.E.(2009).Chapter 2: Automotive Careers and ASE Certification. 15-18. Workbook - Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodheart-Willcox Company, Inc.
Snap-on Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions

Web base training software: ShopKey 5 Service Information
Automotive Technology Workbooks
MSDS hand book
NATEF Task Assessment Worksheet
Computers
Text book: Service Information (ShopKey 5)
Common hand tools:
Wrenches--open end, box end, and combination
Sockets--shallow, deep, 6-point, 12-point, standard, and impact
Drive size--1/4 inch, 3/8 inch, 1/2 inch, and 3/4 inch
Socket accessories--speed handle, extensions 3 to 36 inches long, universals, flex handle, and T bar
Screwdrivers--flat blade (standard), Phillips, clutch, and Torx
Pliers--slip joint, water pump, diagonal cutting, vise grip, snap ring, needle nose, battery, and duck bill
Punches--taper, pin, and center
Hammers--ball peen, soft face, and brass
Electronic Stethoscope
Brake Flaring Tool Kit
Micrometer Measuring Tool
Caliber Measuring Tool
Dial Indicator Measuring Tool
Above the ground vehicle lifts
Drive-On lifts with hydraulic jacks
Tripod Jack Stands
Screw Jack Stand
Standard Jack Stand
Four 2 ½ ton Floor Jacks
Torque Wrenches: 3/8 – ½ inch Drive
Inch Pound Torque Wrench
Stationary AAMCO Brake Lathe
Hunter On-Vehicle Brake Lathe
Two Electric Reversible Drills
½ Inch Drive Impact Wrench – battery operated
½ Inch Drive Impact Air Wrench
3/8 Drive Air Impact Ratchet
¼ Air Impact Ratchet
Air Powered Cut-Off Wheel Tool
Air Powered Hammer / Chisel Tool
Air Powered Grinder Tool Kit
Bench Grinder / Wire Wheel Tool
Oxy/acetylene cutting torch
Drain pans and funnels
School –Owned Shop Vehicles – 2002 Chevy S-10 Pick-up Truck, 1999 Chevy Cavaliers (2), 1995 Pontiac Bonneville, 1991 Honda Civic, 1991 Chevy Lumina, 1997 Jeep Cherokee, 2001 Chevy Astro Van, 1991 Ford Ranger Pick-up Truck, 1991 Buick Regal, 1991 Chevy Corsica, 1998 Subaru Legacy, 1998 Mitsubishi Mirage
Hyperlinks:

www.g-wonlinetextbooks.com

www.sp2.org

www.library.alldatapro.com

Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA700 – ELECTRICAL / ELECTRONIC SYSTEMS

Unit Number: PA700

Dates: Spring 2016 **Hours:** 320.00

Last Edited By: Automotive Technology (05-12-2016)

Description / Objectives:

Student will know and be able to test, repair, and replace electrical and electronics systems.

Tasks:

PA701 - Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

PA702 - Identify and interpret electrical/electronic system concern; determine necessary action.

PA703 - Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technical service bulletins.

PA704 - Locate and interpret vehicle and major component identification numbers.

PA705 - Use wiring diagrams during diagnosis of electrical circuit problems.

PA706 - Check electrical circuits with a test light; determine necessary action.

PA707 - Check electrical circuits using fused jumper wires; determine necessary action.

PA708 - Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.

PA709 - Measure and diagnose the cause(s) of excessive parasitic draw; determine necessary action.

PA710 - Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.

PA711 - Inspect and test switches, connectors, relays, solenoid solid state devices, and wires of electrical/electronic circuits; perform necessary action.

PA712 - Remove and replace terminal end from connector; replace connectors and terminal ends.

PA713 - Repair wiring harness (including CAN/BUS systems).

PA714 - Perform solder repair of electrical wiring.

PA715 - Identify location of hybrid vehicle high voltage circuit disconnect (service plug) location and safety procedures.

PA716 - Perform battery state-of-charge test; determine necessary action.

PA717 - Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action.

PA718 - Maintain or restore electronic memory functions.

PA719 - Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps, and hold-downs.

PA720 - Perform battery charge.

PA721 - Start a vehicle using jumper cables or an auxiliary power supply.

PA722 - Identify electronic modules, security systems, radios, and other accessories that require reinitialization or code entry following battery disconnect.

PA723 - Perform starter current draw tests; determine necessary action.

PA724 - Perform starter circuit voltage drop tests; determine necessary action.

PA725 - Inspect and test starter relays and solenoids; determine necessary action.

PA726 - Remove and install starter in a vehicle.

PA727 - Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.

PA728 - Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition.

PA729 - Perform charging system output test; determine necessary action.

PA730 - Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions.

PA731 - Inspect, adjust, or replace generator (alternator) drive belts, pulleys, and tensioners; check pulley and belt alignment.

PA732 - Remove, inspect, and install generator (alternator).

PA733 - Perform charging circuit voltage drop tests; determine necessary action.

PA734 - Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.

PA735 - Inspect, replace, and aim headlights and bulbs.

PA736 - Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.

PA737 - Inspect and test gauges and gauge sending units for cause of abnormal gauge readings; determine necessary action.

PA738 - Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.

PA739 - Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.

PA740 - Diagnose incorrect horn operation; perform necessary action.

PA741 - Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.

PA742 - Diagnose incorrect washer operation; perform necessary action.

PA743 - Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.

PA745 - RESERVED

PA746 - Remove and reinstall door panel.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.

Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.

Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.

CRAFT & STRUCTURE GRADES 9-10-11-12
Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key

terms, and other domain specific words.

Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.

Standard CC.3.5.9-10.F / Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure...and Analyze the structure of the relationships among concepts in a text.

INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).

Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.

Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.

INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12
Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.

Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.

Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.

RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Focus Anchor/Standard #2:

- Pennsylvania Core Standards for Writing for Technical Subjects Standard 3.6

Supporting Anchor/Standards:

TEXT TYPES AND PURPOSE GRADES 9-10-11-12
Standard CC.3.6.9-10.A Standard CC.3.6.11-12.A Write arguments focused on discipline specific content.

Standard CC.3.6.9-10.B Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes, etc.

PRODUCTION & DISTRIBUTION OF WRITING GRADES 9-10-11-12
Standard CC.3.6.9-10.C Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience.

Standard CC.3.6.9-10 D Standard CC.3.6.11-12.D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

Standard CC.3.6.9-10.E Standard CC.3.6.11-12.E. Use technology, including the internet, to produce, publish, and update individual or shared writing products.

RESEARCH GRADES 9-10-11-12
Standard CC.3.6.9-10.F Standard CC.3.6.11-12.F Conduct short and more sustained research to answer a question or solve a problem.

Standard CC.3.6.9-10.G. Standard CC.3.6.11-12.G Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation.

Standard CC.3.6.9-10.H. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.

RANGE OF WRITING GRADES 9-10-11-12
Standard CC.3.5.9-10.I & Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences...etc.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.

Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

GEOMETRY
Standard 2.3.HS.A.7 Apply trigonometric ratios to solve problems involving right triangles.
Standard 2.3.HS.A.3 Verify and apply geometric theorems as they relate to geometric figures.
Standard 2.3.HS.A.13 Analyze relationships between two dimensional and three dimensional objects.

Instructional Activities:

Knowledge:

Explain the principles of electricity.
Describe the action of basic electric circuits.
Compare voltage, current, and resistance.
Describe the principles of magnetism and magnetic fields.
Identify basic electric and electronic terms and components.
Explain different kinds of automotive wiring.
Perform fundamental electrical tests.
Correctly answer ASE certification test questions that require a basic understanding of electricity and electronics.
Explain the operating principles of a lead-acid battery.
Describe the basic parts of an automotive battery.
Compare conventional and maintenance-free batteries.
Explain how temperature and other factors affect battery performance.
Describe safety practices that should be followed when working with batteries.
Correctly answer ASE certification test questions that require a basic knowledge of automotive batteries.
Visually inspect a battery for obvious problems.
Describe safety practices to follow when testing and servicing batteries.

Correctly answer ASE certification test questions on battery service.
Explain the principles of an electric motor.
Describe the construction and operation of a starting motor.
Sketch a simple starting system circuit.
Explain the operation of solenoids.
List the functions of the main starter drive parts.
Describe starter drive operation.
Compare different types of starting motors.
Describe starting system safety features.
Correctly answer ASE Certification test questions that require a knowledge of starting system fundamentals.
Explain typical procedures for a starting motor rebuild.
Describe the safety practices that should be followed when testing or repairing a starting system.
Correctly answer ASE certification test questions on starting system diagnosis, service, and repair.

Explain the operating principles of automotive light, wiper, and horn systems.
Summarize automatic light and wiper systems.
Explain how to aim headlights.
Describe the safety practices to follow when working with light, wiper, and horn systems.
Explain both analog and digital instrumentation.
Summarize how to remove and service an instrument cluster.
Correctly answer ASE certification test questions on light, instrumentation, wiper, and horn systems.

Describe the operating principles of a radio.
Explain the basic difference between AM and FM radios.
Explain the operation and service of power windows.
Sketch a rear window defogger circuit.
Describe and repair a power lock system.
Summarize the operation and testing of a speed control system.
Describe safety practices that must be followed when working with electrical accessory circuits.
Correctly answer ASE certification test questions on the service of sound systems and power accessories.

List the basic parts of a charging system.
Explain charging system operation.
Describe the construction of major charging system components.
Compare alternator and voltage regulator design differences.
Explain charging system indicators.
Describe safety practices to follow when working with charging systems.
Correctly answer ASE certification test questions that require a knowledge of charging system fundamentals.
Describe safety practices to follow when testing or repairing a charging system.
Correctly answer ASE certification test questions on charging system diagnosis and repair.

Identify the major parts of a hybrid drive system.
Explain the construction and operation of hybrid drive assemblies.
List the safety measures that must be followed when working on high-voltage hybrid drive systems.
Use on-board diagnostics to find the source of problems in a hybrid vehicle propulsion system.
Identify the most common problems that occur in a hybrid vehicle drive system.
Perform basic tests to verify hybrid drive trouble codes.
Safely remove and replace a hybrid battery pack, power control module, power cables, ECUs, and motor-generator assemblies.

Explain how vehicle body and frame construction works with restraint systems to protect a vehicle's occupants.
Identify and locate the most important parts of vehicle restraint systems.
Describe the purpose of restraint systems.

Describe restraint system design variations.
Summarize the operation of restraint system sensors, inflator modules, and electronic control modules.
Correctly answer ASE certification test questions requiring a knowledge of restraint system operation and construction.

Explain how to inspect and repair seat belts.
Summarize how to scan restraint systems for problems.
Describe safety rules for working with air bags.
Summarize the procedure for air bag replacement.
Explain how to replace air bag sensors.
Describe how to service an air bag controller.
Correctly answer ASE certification test questions about the diagnosis and repair of restraint systems.

Explain the operation of vehicle security systems.
Explain the operation of vehicle navigation systems.
Compare security system design variations.
Summarize the operation of alternate power sources for vehicles.
Discuss how engineers might change vehicle designs in the future to increase safety, comfort, dependability, and environmental control of our planet.

Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
List and describe the troubleshooting steps.
Demonstrate the usage of a DVOM measuring tool.
Read wiring schematics.

Skill:

Perform common battery tests.
Clean a battery case and terminals.
Charge a battery.
Jump-start a car using a second battery.
Replace a defective battery.
Diagnose common starting system troubles.
Make orderly starting system tests.
Remove and replace a starting motor.
Explain typical procedures for a starting motor rebuild.
Adjust a neutral safety switch.
Diagnose charging system troubles.
Inspect a charging system.
Test charging system output with a voltmeter or a load tester.
Remove, test, repair, and replace an alternator.
Adjust an alternator belt.
Remove and replace a voltage regulator
Diagnose problems in light, wiper, and horn systems.
Replace burned-out bulbs.
Diagnose basic sound system problems.
Test and evaluate electrical systems.
Disassemble, test, and reassemble components.
Demonstrate use of AVR Battery/Alternator/Starter Tester.
Demonstrate use of test light.
Solder and repair wiring.
Disable and re-enable Supplemental Inflatable Restraint System.

VI. ELECTRICAL/ELECTRONIC SYSTEMS

A. General Electrical System Diagnosis

11. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 94–95
12. Identify and interpret electrical/electronic system concern; determine necessary action. P-1 641–642, 657–662, 665, 666
13. Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technical service bulletins. P-1 85–95
14. Locate and interpret vehicle and major component identification numbers. P-1 86, 87
15. Diagnose electrical/electronic integrity of series, parallel and series parallel circuits using principles of electricity (Ohm's Law). P-1 99, 659–662
16. Use wiring diagrams during diagnosis of electrical circuit problems. P-1 661
17. Demonstrate the proper use of a digital multimeter (DMM) during diagnosis of electrical circuit problems, including: source voltage, voltage drop, current flow, and resistance. P-1 106
18. Check electrical circuits with a test light; determine necessary action. P-2 102–103
19. Check electrical/electronic circuit waveforms; interpret readings and determine needed repairs. P-2 880–891
20. Check electrical circuits using fused jumper wires; determine necessary action. P-2105–106 Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action. P-1 659–661
21. Measure and diagnose the cause(s) of excessive parasitic draw; determine necessary action. P-1 488, 489
22. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action. P-1 100, 660, 661
23. Inspect and test switches, connectors, relays, solenoid solid-state devices and wires of electrical/electronic circuits; perform necessary action. P-1 102–107, 641–642,659–661
24. Remove and replace terminal end from connector; replace connectors and terminal ends. P-1 104–105
25. Repair wiring harness (including CAN/BUS systems). P-1 103–105
26. Perform solder repair of electrical wiring. P-1 104, 105
27. Identify location of hybrid vehicle high voltage circuit disconnect (service plug) location and safety procedures. P-2 710–711

B. Battery Diagnosis and Service

11. Perform battery state-of-charge test; determine necessary action. P-1 486–488
12. Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action. P-1 487, 488, 492, 493
13. Maintain or restore electronic memory functions. P-1 277
14. Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps, and hold-downs. P-1 134, 483–486, 494, 517
15. Perform battery charge. P-1 489–492
16. Start a vehicle using jumper cables or an auxiliary power supply. P-1 491, 492
17. Identify high voltage circuits of electric or hybrid electric vehicle and related safety precautions. P-3 698–706, 709–711

C. Starting System Diagnosis and Repair

11. Perform starter current draw tests; determine necessary action. P-1 514–517
12. Perform starter circuit voltage drop tests; determine necessary action. P-1 492, 493, 517, 518
13. Inspect and test starter relays and solenoids; determine necessary action. P-2 517, 518
14. Remove and install starter in a vehicle. P-1 520–521, 527
15. Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action. P-2 518, 519, 1119–1122
16. Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition. P-2 513–519

D. Charging System Diagnosis and Repair

11. Perform charging system output test; determine necessary action. P-1 551
12. Diagnose charging system for the cause of undercharge, no-charge and overcharge conditions.
    P-1 548–556

13. Inspect, adjust, or replace generator (alternator) drive belts, pulleys and tensioners; check pulley and belt alignment. P-1 548–550, 557, 560
14. Remove, inspect, and install generator (alternator). P-1 556–562
15. Perform charging circuit voltage drop tests; determine necessary action. P-1 553–555

E. Lighting Systems Diagnosis and Repair
11. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action. P-1 632–635, 641–642
12. Inspect, replace, and aim headlights and bulbs. P-2 641, 642–647
13. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action. P-2 635–639, 642–644
14. Identify system voltage and safety precautions associated with high intensity discharge headlights. P-2 634

F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair
11. Inspect and test gauges and gauge sending units for cause of abnormal gauge readings; determine necessary action. P-1 285–288, 647–653, 762–763, 798
12. Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action. P-3 651, 652, 653
13. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action. P-1 653–654, 683, 688
14. Inspect and test sensors, connectors, and wires of electronic (digital) instrument circuits; determine necessary action. P-3 285–288, 651, 652, 659–662

G. Horn and Wiper/Washer Diagnosis and Repair
11. Diagnose incorrect horn operation; perform necessary action. P-1 658, 659
12. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action. P-1 657, 658
13. Diagnose incorrect washer operation; perform necessary action. P-2 658

H. Accessories Diagnosis and Repair
11. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action. P-1 674–681
12. Diagnose incorrect heated glass, mirror, or seat operation; determine necessary action. P-3 682, 683
13. Diagnose incorrect electric lock operation (including remote keyless entry); determine necessary action. P-1 678
14. Diagnose incorrect operation of cruise control systems; determine necessary action. P-3 684–687
15. Diagnose supplemental restraint system (SRS) concerns; determine necessary action. P-1 1535–1540
16. Disarm and enable the airbag system for vehicle service. P-1 1535
17. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action. P-3 669
18. Remove and reinstall door panel. P-1 680, 681
19. Diagnose body electronic system circuits using a scan tool; determine necessary action. P-2 268–271
20. Check for module communication (including CAN/BUS systems) errors using a scan tool. P-2 268, 269, 270
21. Diagnose the cause of false, intermittent, or no operation of anti-theft systems. P-3 1544–1547
22. Perform software transfers, software updates, or flash reprogramming on electronic modules.

Remediation:

Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:

Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.

Working on skills for SkillsUSA, Lehigh Valley Dealers Association, and/or Northampton Community College competitions

Special Adaptations:

Extended Time (assignments and/or testing)
Preferential Seating
Directions/Comprehension Check (frequent checks for understanding)
Study Guide
Directions and/or Tests Read Aloud
Adapted Tests and/or Assignments
Use of Calculator
Taking Tests in Alternate Setting (or if requested)
Verbal/Gestural Redirection (prompts to remain on task)
Drill and Practice (Repetition of Material)
Small Group Instruction
Provide Visual Model to Accompany Verbal Directions (Written/Oral Directions)
Use of Computer (Access to)
Positive Reinforcement
Have Student Repeat Directions
Wait Time
Access to School Counselor
Use of Highlighter/Highlighted Text
Provide Frequent Feedback
Provide Frequent Breaks
Regular Notebook Check
Variety of Assessment Methods
Highly Structured Classroom
Syllabus for Major Projects
Limited, Short Directions
Grading Rubric
Communication Regarding Behavior & Consequences (PBS)
Clear Language for Directions
Provide Opportunities to Retest
Frequent Review Sessions
Use a variety of Modalities when Introducing Skills/Concepts
Allow Oral Answers for Testing
Cue for Oral Response
De-Escalation Opportunities
Daily Classwork Check
Encourage Student to Check Work Before Turning In
Opportunities for Repeated Practice of MATH Skills
Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage
Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Safety:

Student Must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards.
Know and follow the established safety rules at all times.

Assessment:

Written test	Time Cards	Diagrams
Activity worksheets	Writing Activities	Individual Projects
Workbooks	Video/DVD Worksheets	Group Projects
Quizzes	Rubrics	Research Papers
Pre/Post Tests	Check Lists	Current Events
Essays	Debates	
Summaries	Oral Presentation	

Resources/Equipment:

Duffy, J.E.(2009).Module 1, Lesson 2: Automotive Careers and Required Skills. 22-33.Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Module 1, Lesson 8: Basic Electricity and Electronics, Modern Technology Service Technician (MAST). (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Duffy, J.E. (2009).Chapter 2: Automotive Careers and ASE Certification. 15-18. Workbook - Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodheart-Willcox Company, Inc.

Snap-on Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions
Web base training software: ShopKey 5 Service Information
Automotive Technology Workbooks
MSDS hand book
NATEF Task Assessment Worksheet
Computers
Web base training - Service Information (ShopKey 5)
Common hand tools:
Wrenches--open end, box end, and combination
Sockets--shallow, deep, 6-point, 12-point, standard, and impact
Drive size--1/4 inch, 3/8 inch, 1/2 inch, and 3/4 inch
Socket accessories--speed handle, extensions 3 to 36 inches long, universals, flex handle, and T bar
Screwdrivers--flat blade (standard), Phillips, clutch, and Torx
Pliers--slip joint, water pump, diagonal cutting, vise grip, snap ring, needle nose, battery, and duck bill
Punches--taper, pin, and center
Hammers--ball peen, soft face, and brass
Fluke Digital Volt Ohm Meter
Oscilloscope – Snap-On Vantage Meter
Torque Wrenches: 3/8 – ½ inch Drive
Inch Pound Torque Wrench
AVR Snap-On Battery /Starter/ Charging System Station
Two Battery Chargers
Two Battery Booster Packs
School –Owned Shop Vehicles – 2002 Chevy S-10 Pick-up Truck, 1999 Chevy Cavaliers (2), 1995 Pontiac Bonneville, 1991 Honda Civic, 1991 Chevy Lumina, 1997 Jeep Cherokee, 2001 Chevy Astro Van, 1991 Ford Ranger Pick-up Truck, 1991 Buick Regal, 1991 Chevy Corsica, 1998 Subaru Legacy, 1998 Mitsubishi MirageHyperlinks:

www.g-wonlinetextbooks.com www.sp2.org www.library.alldatapro.com

Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA800 - ENGINE PERFORMANCE
Unit Number: PA800

Dates: Spring 2016 **Hours:** 284.00

Last Edited By: Automotive Technology (05-12-2016)

Unit Description/Objectives:

Student will know and be able to check, test, evaluate, diagnose, analyze, service, repair, replace, and interpret all components of engine performance.
Student will demonstrate maintenance procedures, identify the purpose of the cooling system, lubrication system, fuel system and components.

Tasks:

PA801 - Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

PA802 - Identify and interpret engine performance concern; determine necessary action.

PA803 - Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins.

PA804 - Locate and interpret vehicle and major component identification numbers.

PA805 - Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.

PA806 - Diagnose abnormal engine noise or vibration concerns; determine necessary action.

PA807 - Diagnose abnormal exhaust color, odor, and sound; determine necessary action.

PA808 - Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.

PA809 - Perform cylinder power balance test; determine necessary action.

PA810 - Perform cylinder cranking and running compression tests; determine necessary action.

PA811 - Perform cylinder leakage test; determine necessary action.

PA812 - Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action.

PA813 - Verify engine operating temperature; determine necessary action.

PA814 - Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.

PA815 - Verify correct camshaft timing.

PA816 - Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable.

PA817 - Diagnose the causes of emissions or drivability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data.

PA818 - Access and use service information to perform step-by-step diagnosis.

PA819 - Perform active tests of actuators using a scan tool; determine necessary action.

PA820 - Describe the importance of running all OBDII monitors for repair verification.

PA821 - Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor drivability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action.

PA822 - Inspect and test ignition primary and secondary circuit wiring and solid state components; test ignition coil(s); perform necessary action.

PA823 - Inspect and test crankshaft and camshaft position sensor(s); perform necessary action.

PA824 - Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary.

PA825 - Diagnose hot or cold no-starting, hard starting, poor drivability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action.

PA826 - Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action.

PA827 - Replace fuel filters.

PA828 - Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.

PA829 - Inspect and test fuel injectors.

PA830 - Verify idle control operation.

PA831 - Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.

PA832 - Diagnose oil leaks, emissions, and drivability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action.

PA833 - Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.

PA834 - Diagnose emissions and drivability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action.

PA835 - Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters and hoses; perform necessary action.

PA836 - Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.

PA837 - Inspect and test mechanical components of secondary air injection systems; perform necessary action.

PA838 - Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.

PA839 - Inspect and test catalytic converter efficiency.

PA840 - Diagnose emissions and drivability concerns caused by the evaporative emissions control system; determine necessary action.

PA841 - Inspect and test components and hoses of the evaporative emissions control system; perform necessary action.

PA842 - Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action.

PA843 - Remove and replace timing belt; verify correct camshaft timing.

PA844 - Remove and replace thermostat and gasket/seal.

PA845 - Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.

PA846 - Perform engine oil and filter change.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.

Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.

Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.

CRAFT & STRUCTURE GRADES 9-10-11-12
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INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12
Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.

Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.

Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.

RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Focus Anchor/Standard #2:

- Pennsylvania Core Standards for Writing for Technical Subjects Standard 3.6

Supporting Anchor/Standards:

TEXT TYPES AND PURPOSE GRADES 9-10-11-12
Standard CC.3.6.9-10.A Standard CC.3.6.11-12.A Write arguments focused on discipline specific content.

Standard CC.3.6.9-10.B Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes, etc.

PRODUCTION & DISTRIBUTION OF WRITING GRADES 9-10-11-12
Standard CC.3.6.9-10.C Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience.

Standard CC.3.6.9-10 D Standard CC.3.6.11-12.D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

Standard CC.3.6.9-10.E Standard CC.3.6.11-12.E. Use technology, including the internet, to produce, publish, and update individual or shared writing products.

RESEARCH GRADES 9-10-11-12
Standard CC.3.6.9-10.F Standard CC.3.6.11-12.F Conduct short and more sustained research to answer a question or solve a problem.

Standard CC.3.6.9-10.G. Standard CC.3.6.11-12.G Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation.

Standard CC.3.6.9-10.H. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.

RANGE OF WRITING GRADES 9-10-11-12
Standard CC.3.5.9-10.I & Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences...etc.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.

Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

GEOMETRY
Standard 2.3.HS.A.7 Apply trigonometric ratios to solve problems involving right triangles.
Standard 2.3.HS.A.3 Verify and apply geometric theorems as they relate to geometric figures.
Standard 2.3.HS.A.13 Analyze relationships between two dimensional and three dimensional objects.

Instructional Activities:

Knowledge:

Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
List all the parts of the cylinder head, engine oiling system, and cooling system.
Analyze the purposes of valve guides, seals, seats, springs, keepers, retainers, rotators.
Identify the parts in the valve operating mechanism including lifters, pushrods, rocker-arms, camshaft, oil gauges.
Explain the importance of vehicle maintenance.
Correctly answer ASE certification test questions on fluid service and vehicle maintenance.

Summarize the functions of a cooling system.
Explain the operation and construction of major cooling system components.
Compare cooling system design variations.
Explain the importance of antifreeze.
Discuss safety procedures to follow when working with cooling systems.
Correctly answer ASE certification test questions on cooling system construction and operation.

List common cooling system problems and their symptoms.
Describe the most common causes of system leakage, overheating, and overcooling.
Describe safe working practices to use when testing, maintaining, or repairing a cooling system.
Correctly answer ASE certification test questions on cooling system troubleshooting and repair.

Explain why proper diagnosis methods are important to engine repair.
List common symptoms of engine mechanical problems.
Discuss how to find abnormal engine noises.
Summarize procedures for gasoline and diesel engine compression testing.
Explain when and how to do a wet compression test.
Summarize common causes of engine mechanical problems.
Discuss safety practices to follow while performing engine inspections.
Correctly answer ASE certification test questions on engine mechanical problems.

Determine if engine removal is needed to make specific engine repairs.
List the preparations for engine removal.
Describe the general safety rules pertaining to engine removal, disassembly, and parts cleaning.
Explain the use of an engine lifting fixture or chain, and an engine crane.
Summarize how to properly disassemble an engine.
Describe typical inspections that should be made during engine disassembly and cleaning.
List various methods for cleaning engine parts.
Describe safety practices to follow when cleaning parts.
Correctly answer ASE certification test questions on engine removal, disassembly, and cleaning procedures.

Compare computer systems to the human body's nervous system.
Describe the input, processing, and output sections of a basic computer system.
Explain input sensor and output device classifications and operation.
Summarize computer system signal classifications.
Sketch a block diagram for a computer system.
Summarize where computers, control modules, sensors, and actuators are typically located.
Summarize the flow of data through a computer.
Explain how a computer uses sensor inputs to determine correct outputs.
Correctly answer ASE certification test questions that require a knowledge of automotive computer system fundamentals.

Discuss the purpose and operation of on-board diagnostic systems.
Explain the use of scan tools to simplify reading of trouble codes.
Compare OBD I and OBD II system capabilities and procedures.
Correctly answer ASE certification test questions concerning late-model on-board diagnostics and scan tool use.
Correctly answer ASE certification test questions on servicing computer system components.

Define the major parts of a fuel supply system.
Describe the operation of mechanical and electric fuel pumps.
Describe the construction and action of air filters.
Explain the tests used to diagnose problems with fuel pumps, fuel filters, and fuel lines.
State safety rules for working on fuel supply systems.
Correctly answer ASE certification test questions on fuel tanks, fuel pumps, fuel lines, fuel filters, and air filters.

List some of the possible advantages of gasoline injection.
Describe the classifications of gasoline injection.
Explain the operation of electronic throttle body gasoline injection.
Explain the operation of electronic multiport gasoline injection.
Summarize the operation of airflow-sensing, hydraulic-mechanical (continuous), and pressure-sensing gasoline injection systems.
Compare the various types of gasoline injection systems.
Correctly answer ASE certification test questions on gasoline injection systems.
Explain OBD II testing features used on late-model fuel injection systems.
Cite safety rules for injection system service.
Correctly answer ASE certification test questions about fuel injection system diagnosis, service, and repair.

Explain the operating principles of an automotive ignition system.
Compare contact point, electronic, and computer-controlled ignition systems.
Describe the function of major ignition system components.
Explain vacuum, centrifugal, and electronic ignition timing advance.
Sketch the primary and secondary sections of an ignition system.
Compare ignition coil, spark plug, and distributor design variations.
Describe the safety practices that must be followed when working with ignition systems.
Correctly answer ASE certification test questions that require a knowledge of ignition system fundamentals.
List the symptoms produced by faulty ignition system components.
Describe common tests used to find ignition system troubles.
Explain how to replace or repair ignition system parts.
Summarize contact point and pickup coil adjustments.

Define the fundamental terms relating to automotive emission control systems.
Explain the sources of air pollution.
Describe the operating principles of emission control systems.
Compare design differences in emission control systems.
Explain how a computer or engine control module can be used to operate emission control systems.
Summarize how OBD II systems use multiple oxygen sensors to check air-fuel mixture and catalytic converter efficiency.
Correctly answer ASE certification test questions that require a knowledge of emission control system operation and construction.

Describe the basic parts of an exhaust system.
Compare exhaust system design differences.
Explain the fundamental parts of a turbocharging system.
Describe the construction and operation of a turbocharger and waste gate.
Summarize the construction and operation of a supercharging system.
Demonstrate an understanding of safety procedures for working on exhaust systems, turbochargers, and superchargers.
Correctly answer ASE certification test questions on exhaust system, turbocharger, and supercharger operation and service.

List the most common engine performance ¬problems.
Describe the symptoms for common engine performance problems.
Explain typical causes of engine performance problems.
Use a systematic approach when diagnosing engine performance problems.
Correctly answer ASE certification test questions on problems affecting engine performance.
Explain the principles of an oscilloscope.
Summarize how to use waveforms to analyze the operation of sensors, actuators, ECU outputs, and other electrical-electronic devices.
Evaluate ignition system waveforms.
Summarize how to use an engine analyzer.

Describe the typical difference between a minor tune-up.
List the basic steps for an engine tune-up.
Explain service operations commonly performed during a tune-up.
List the safety precautions that should be remembered during a tune-up.
Correctly answer ASE certification test questions on engine tune-up and engine problem diagnosis.

Skills:

Check a car's fluid levels.
Locate fluid leaks.
Replace engine oil and filter.
Change automatic transmission fluid and filter.
Perform a grease job.
Inspect for general problems with hoses, belts, and other components.
Demonstrate safe practices while working with vehicle fluids.
Perform a combustion leak test and a system pressure test.
Check the major parts of a cooling system for proper operation.
Replace faulty cooling system components.
Drain, flush, and refill a cooling system.

Locate the data link connector on most makes and models of cars.
Activate on-board diagnostics and read trouble codes with and without a scan tool.
Use a trouble code chart in a service manual or code conversion by a scan tool.
Erase diagnostic trouble codes.
Perform a visual inspection of the engine, its sensors, actuators, and the systems they monitor and control.
Test sensors and their circuits.
Remove and replace sensors.
Test and replace actuators.
Remove and replace a computer.
Remove and replace a computer PROM.
Program an EEPROM.
Demonstrate safe working practices when servicing automotive computers.

Repair a fuel line or replace a fuel hose.
Locate and replace fuel filters in both gasoline and diesel fuel systems.
Diagnose typical gasoline injection system problems.
Test a fuel pressure regulator.
Test both electronic and continuous fuel injectors.

Use a service manual when making basic adjustments on gasoline injection systems.

Diagnose typical ignition system problems.
Adjust ignition timing.

Inspect and troubleshoot emission control systems.
Perform periodic service operations on emission control systems.
Test individual emission control components.
Replace or repair major emission control components.
Demonstrate and practice safe work procedures.

Perform exhaust system repairs.
Remove and replace a turbocharger and waste gate.

Use advanced diagnostic techniques to troubleshoot difficult problems.
Use scan tool snapshot and datastream values to find problems not tripping trouble codes.
Use a breakout box to measure circuit values.

I. ENGINE REPAIR
A. General Engine Diagnosis; Removal and Reinstallation (R & R)
Task Number and Description Priority Page #s

11. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 94–95
12. Identify and interpret engine concern; determine necessary action. P-1 137, 138–139, 871–896, 913–926
13. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins. P-1 85–95
14. Locate and interpret vehicle and major component identification numbers. P-1 86, 87, 269, 1072, 1110
15. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action. P-1 746, 786–788, 915
16. Diagnose engine noises and vibrations; determine necessary action. P-2 138, 139, 916
17. Diagnose the cause of excessive oil consumption, coolant consumption, unusual engine exhaust color and odor; determine necessary action. P-2 872–874, 892
18. Perform engine vacuum tests; determine necessary action. P-1 872–874, 892
19. Perform cylinder power balance tests; determine necessary action. P-2 895
20. Perform cylinder cranking and running compression tests; determine necessary action. P-1 916–920
21. Perform cylinder leakage tests; determine necessary action. P-1 920
22. Remove and reinstall engine in an OBDII or newer vehicle; reconnect all attaching components and restore the vehicle to running condition. P-2 931–937, 1011, 1012
23. Install engine covers using gaskets, seals, and sealers as required. P-1 119–124, 996–997, 1006–1007
24. Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads, and repair internal threads with thread insert. P-1 117–120
25. Inspect, remove, and replace engine mounts. P-2 925–926, 932–935

B. Cylinder Head and Valve Train Diagnosis and Repair

11. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specifications and procedures. P-1 115–117, 942, 943, 990, 991
12. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition. P-1 938, 939, 971–974
13. Inspect valve springs for squareness and free height comparison; determine necessary action. P-3 983, 984
14. Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine necessary action. P-3 984–986

15. Inspect valve guides for wear; check valve stem-to-guide clearance; determine necessary action. P-3 974–976
16. Inspect valves and valve seats; determine necessary action. P-3 974–983, 986
17. Check valve spring assembled height and valve stem height; determine necessary action. P-3 984
18. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action. P-2 989
19. Inspect valve lifters; determine necessary action. P-2 988, 989
20. Adjust valves (mechanical or hydraulic lifters). P-1 993–996
21. Inspect and replace camshaft and drive belt/chain (includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and variable valve timing components). P-1 983–986, 989–993
22. Inspect and/or measure camshaft for runout, journal wear, and lobe wear. P-2 987, 988
23. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine necessary action. P-2 988

C. Engine Block Assembly Diagnosis and Repair
11. Disassemble engine block; clean and prepare components for inspection and reassembly. P-1 940–945
12. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action. P-2 948–955, 973
13. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine necessary action. P-2 950, 951, 953, 954
14. Deglaze and clean cylinder walls. P-2 951–953
15. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action. P-3 988
16. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and journal wear; check crankshaft position sensor reluctor ring (where applicable); determine necessary action. P-1 960–961, 963–964
17. Inspect main and connecting rod bearings for damage and wear; determine necessary action. P-2 958, 961–963, 965
18. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine necessary action. P-3 949, 954, 955
19. Inspect and measure piston skirts and ring lands; determine necessary action. P-2 941, 954–958, 964, 965
20. Remove and replace piston pin. P-3 956, 957, 958
21. Determine piston-to-bore clearance. P-2 955–956
22. Inspect, measure, and install piston rings. P-2 941, 955–956, 958–960
23. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance or silencer); inspect shaft(s) and support bearings for damage and wear; determine necessary action; reinstall and time. P-2 936, 954, 955, 987, 988
24. Remove, inspect, or replace crankshaft vibration damper (harmonic balancer). P-2 217
25. Assemble engine block. P-1 120–124, 791–793, 962, 990–993, 996, 997, 1004–1007

D. Lubrication and Cooling Systems Diagnosis and Repair
11. Perform oil pressure tests; determine necessary action. P-1 789
12. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action. P-2 793–797
13. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; determine necessary action. P-1 747–749
14. Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment. P-1 548–550, 756–757
15. Inspect and replace engine cooling and heater system hoses. P-1 754, 755
16. Inspect, test, and replace thermostat and gasket/seal. P-1 751–754
17. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required. P-1 132, 751, 754, 759–765
18. Inspect, remove and replace water pump. P-2 750, 751

19. Remove and replace radiator. P-2 756
20. Inspect, and test fans(s) (electrical or mechanical), fan clutch, fan shroud, and air dams. P-1 757, 758
21. Inspect auxiliary coolers; determine necessary action. P-3 779
22. Inspect, test, and replace oil temperature and pressure switches and sensors. P-2 798, 799
23. Perform oil and filter change. P-1 128–130
24. Identify causes of engine overheating.

VIII. ENGINE PERFORMANCE

A. General Engine Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 94–95
2. Identify and interpret engine performance concern; determine necessary action. P-1 137–139, 859–866, 871–896, 913–926
3. Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins. P-1 85–95, 862
4. Locate and interpret vehicle and major component identification numbers. P-1 86, 87, 269, 1072, 1110
5. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action. P-2 914–916
6. Diagnose abnormal engine noise or vibration concerns; determine necessary action. P-3 138, 139, 859, 916
7. Diagnose abnormal exhaust color, odor, and sound; determine necessary action. P-2 431, 915, 916
   NATEF Task List Correlation Chart 53
   Task Number and Description Priority Page #s
8. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action. P-1 872–874
9. Perform cylinder power balance test; determine necessary action. P-2 895
10. Perform cylinder cranking and running compression tests; determine necessary action. P-1 906, 916–920
11. Perform cylinder leakage test; determine necessary action. P-1 920
12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action. P-1 107, 108, 282–294, 599, 880–896
13. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action. P-3 833–836, 837–840
14. Verify engine operating temperature; determine necessary action. P-1 752
15. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action. P-1 746–749, 755, 756, 759–761
16. Verify correct camshaft timing. P-1 1001–1004, 1009

B. Computerized Engine Controls Diagnosis and Repair

1. Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable. P-1 268–277
2. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data. P-1 268–277, 373, 374, 384–391, 622, 846–849
3. Diagnose emissions or driveability concerns without stored diagnostic trouble codes; determine necessary action. P-1 283–294, 373, 374, 384–391, 622, 846–849
4. Check for module communication (including CAN/BUS systems) errors using a scan tool. P-2 284
5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO); perform necessary action. P-1 282–294, 384–388, 622
6. Access and use service information to perform step-by-step diagnosis. P-1 85–95, 269, 277

7. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems); determine necessary action. P-3 683–687, 1110–1113, 1493, 1544, 1545
8. Perform active tests of actuators using a scan tool; determine necessary action. P-1 273, 875

C. Ignition System Diagnosis and Repair
1. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action. P-1 595, 596, 621, 831, 863–866, 905
2. Inspect and test ignition primary and secondary circuit wiring and solid-state components; test ignition coil(s); perform necessary action. P-1 600–602, 618–619
3. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action. P-1 618
4. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary. P-2 291–294

D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action. P-1 371–392, 403–408, 430–433, 863–867
2. Check fuel for contaminants and quality; determine necessary action. P-2 308–309
3. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action. P-1 329–334
4. Replace fuel filters. P-2 135, 329, 330
5. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.P-2 135, 334,377, 378, 391, 991–993
6. Inspect and test fuel injectors. P-1 376–381
7. Verify idle control operation. P-1 381–383, 407–408, 432–437
8. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action. P-1 450–455
9. Perform exhaust system backpressure test; determine necessary action. P-1 449, 847
10. Test the operation of turbocharger/supercharger systems; determine necessary action. P-3 450–458

E. Emissions Control Systems Diagnosis and Repair
1. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action. P-2 798, 799, 804–809, 831–853
2. Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action. P-2 806–810, 842, 843
3. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action. P-1 811–815, 845, 846
4. Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters and hoses; perform necessary action. P-1 811–815, 845, 846
5. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action. P-2 811–815, 845, 846
6. Diagnose emissions and driveability concerns caused by the secondary air injection and catalytic converter systems; determine necessary action. P-2 815–821, 846–849
7. Inspect and test mechanical components of secondary air injection systems; perform necessary action. P-3 846, 847
8. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action. P-3 846, 847
9. Inspect and test catalytic converter efficiency. P-1 847, 848
10. Diagnose emissions and driveability concerns caused by the evaporative emissions control system; determine necessary action. P-1 808–811, 826, 843, 844

11. Inspect and test components and hoses of the evaporative emissions control system; perform necessary action. P-1 843, 844
12. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action. P-1 831, 832

F. Engine Related Service
1. Adjust valves on engines with mechanical or hydraulic lifters. P-1 993–996
2. Remove and replace timing belt; verify correct camshaft timing. P-1 1009–1011
3. Remove and replace thermostat and gasket/seal. P-1 751–753
4. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action. P-1 757–758
5. Perform common fastener and thread repairs, to include: remove broken bolt, restore internal and external threads, and repair internal threads with a threaded insert. P-1 117–120
6. Perform engine oil and filter change. P-1 129–130
7. Identify hybrid vehicle internal combustion engine service precautions.

Remediation:

Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:

Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.
Working on skills for SkillsUSA, Lehigh Valley Dealers Association, and/or Northampton Community College competitions

Special Adaptations:

Extended Time (assignments and/or testing)
Preferential Seating
Directions/Comprehension Check (frequent checks for understanding)
Study Guide
Directions and/or Tests Read Aloud
Adapted Tests and/or Assignments
Use of Calculator
Taking Tests in Alternate Setting (or if requested)
Verbal/Gestural Redirection (prompts to remain on task)
Drill and Practice (Repetition of Material)
Small Group Instruction
Provide Visual Model to Accompany Verbal Directions (Written/Oral Directions)
Use of Computer (Access to)
Positive Reinforcement
Have Student Repeat Directions
Wait Time
Access to School Counselor
Use of Highlighter/Highlighted Text
Provide Frequent Feedback
Provide Frequent Breaks
Regular Notebook Check
Variety of Assessment Methods
Highly Structured Classroom
Syllabus for Major Projects

Limited, Short Directions
Grading Rubric
Communication Regarding Behavior & Consequences (PBS)
Clear Language for Directions
Provide Opportunities to Retest
Frequent Review Sessions
Use a variety of Modalities when Introducing Skills/Concepts
Allow Oral Answers for Testing
Cue for Oral Response
De-Escalation Opportunities
Daily Classwork Check
Encourage Student to Check Work Before Turning In
Opportunities for Repeated Practice of MATH Skills
Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage
Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Safety:

Student Must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards.
Know and follow the established safety rules at all times.

Assessment:

Written test
Activity worksheets
Workbooks
Quizzes
Pre/Post Tests
Essays
Summaries
Time Cards
Writing Activities
Video/DVD Worksheets
Rubrics
Check Lists
Debates
Oral Presentation
Diagrams
Individual Projects
Group Projects
Research Papers
Current Events

Resources/Equipment:

Duffy, J.E.(2009).Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Module 2 Lessons 1-15 Automotive Engines and Module 4 Lessons 1-14 Engine Performance and Computer Fundamentals Modern Technology Service Technician (MAST) On-Line Training. (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Duffy, J.E.(2009). Textbook, Workbook and Student Job Manual - Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodheart-Willcox Company, Inc.

Snap-on Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions

Web base training software: ShopKey 5 Service Information
Automotive Technology Workbooks
MSDS hand book
NATEF Task Assessment Worksheet
Computers
Textbook:
Web base training - Service Information (ShopKey 5)
Common hand tools:
Wrenches--open end, box end, and combination
Sockets--shallow, deep, 6-point, 12-point, standard, and impact
Drive size--1/4 inch, 3/8 inch, 1/2 inch, and 3/4 inch
Socket accessories--speed handle, extensions 3 to 36 inches long, universals, flex handle, and T bar
Screwdrivers--flat blade (standard), Phillips, clutch, and Torx
Pliers--slip joint, water pump, diagonal cutting, vise grip, snap ring, needle nose, battery, and duck bill
Punches--taper, pin, and center
Hammers--ball peen, soft face, and brass
Coolant Pressure Test Kit
Electronic Stethoscope
Fuel Pressure Line Disconnect Kit
Micrometer Measuring Tool
Caliber Measuring Tool
Dial Indicator Measuring Tool
Above the ground vehicle lifts
Drive-On lifts with hydraulic jacks
Tripod Jack Stands
Screw Jack Stand
Standard Jack Stand
Four 2 ½ ton Floor Jacks
Torque Wrenches: 3/8 – ½ inch Drive
Inch Pound Torque wrench
Two Electric Reversible Drills
½ Inch Drive Impact Wrench – battery operated
½ Inch Drive Impact Air Wrench
3/8 Drive Air Impact Ratchet
¼ Air Impact Ratchet
Oil Caddy
Drain pans and funnels
School –Owned Shop Vehicles – 2002 Chevy S-10 Pick-up Truck, 1999 Chevy Cavaliers (2), 1995 Pontiac Bonneville, 1991 Honda Civic, 1991 Chevy Lumina, 1997 Jeep Cherokee, 2001 Chevy Astro Van, 1991 Ford Ranger Pick-up Truck, 1991 Buick Regal, 1991 Chevy Corsica, 1998 Subaru Legacy, 1998 Mitsubishi Mirage
Hyperlinks:
www.g-wonlinetextbooks.com
www.sp2.org
www.library.alldatapro.com

Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA900 - ENGINE REPAIR
Unit Number: PA900

Dates: Spring 2016 **Hours:** 20.00

Last Edited By: Automotive Technology (05-12-2016)

Unit Description/Objectives:
Students will be able to identify, troubleshoot and demonstrate knowledge related to service information regarding engine maintenance.

Tasks:
PA901 - Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.

PA902 - Verify operation of the instrument panel engine warning indicators.

PA903 - Install engine covers using gaskets, seals, and sealers as required.

PA904 - RESERVED

PA905 - Adjust valves (mechanical or hydraulic lifters).

PA906 - Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.

PA907 - Inspect and test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.

Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.

Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.

CRAFT & STRUCTURE GRADES 9-10-11-12
Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key terms, and other domain specific words.

Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.

Standard CC.3.5.9-10.F / Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure...and Analyze the structure of the relationships among concepts in a text.

INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).

Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.

Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.

INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12
Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.

Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.

Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.

RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Focus Anchor/Standard #2:

- Pennsylvania Core Standards for Writing for Technical Subjects Standard 3.6

Supporting Anchor/Standards:

TEXT TYPES AND PURPOSE GRADES 9-10-11-12
Standard CC.3.6.9-10.A Standard CC.3.6.11-12.A Write arguments focused on discipline specific content.

Standard CC.3.6.9-10.B Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes, etc.

PRODUCTION & DISTRIBUTION OF WRITING GRADES 9-10-11-12
Standard CC.3.6.9-10.C Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience.

Standard CC.3.6.9-10 D Standard CC.3.6.11-12.D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

Standard CC.3.6.9-10.E Standard CC.3.6.11-12.E. Use technology, including the internet, to produce, publish, and update individual or shared writing products.

RESEARCH GRADES 9-10-11-12
Standard CC.3.6.9-10.F Standard CC.3.6.11-12.F Conduct short and more sustained research to answer a question or solve a problem.

Standard CC.3.6.9-10.G. Standard CC.3.6.11-12.G Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation.

Standard CC.3.6.9-10.H. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.

RANGE OF WRITING GRADES 9-10-11-12
Standard CC.3.5.9-10.I & Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences...etc.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.

Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

ALGEBRA
Standard 2.2.HS.C.9 Prove the Pythagorean identity and use it to calculate trigonometric ratios.

GEOMETRY
Standard 2.3.HS.A.7 Apply trigonometric ratios to solve problems involving right triangles.
Standard 2.3.HS.A.3 Verify and apply geometric theorems as they relate to geometric figures.
Standard 2.3.HS.A.13 Analyze relationships between two dimensional and three dimensional objects.

Instructional Activities:

Knowledge:

Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
List all the parts of the cylinder head, engine oiling system, and cooling system.
Analyze the purposes of valve guides, seals, seats, springs, keepers, retainers, rotators.
Identify the parts in the valve operating mechanism including lifters, pushrods, rocker-arms, camshaft, oil gauges.
Explain the importance of vehicle maintenance.
Correctly answer ASE certification test questions on fluid service and vehicle maintenance.

Summarize the functions of a cooling system.
Explain the operation and construction of major cooling system components.
Compare cooling system design variations.
Explain the importance of antifreeze.
Discuss safety procedures to follow when working with cooling systems.
Correctly answer ASE certification test questions on cooling system construction and operation.

List common cooling system problems and their symptoms.
Describe the most common causes of system leakage, overheating, and overcooling.
Describe safe working practices to use when testing, maintaining, or repairing a cooling system.
Correctly answer ASE certification test questions on cooling system troubleshooting and repair.

Explain why proper diagnosis methods are important to engine repair.
List common symptoms of engine mechanical problems.
Discuss how to find abnormal engine noises.
Summarize procedures for gasoline and diesel engine compression testing.
Explain when and how to do a wet compression test.
Summarize common causes of engine mechanical problems.
Discuss safety practices to follow while performing engine inspections.
Correctly answer ASE certification test questions on engine mechanical problems.

Determine if engine removal is needed to make specific engine repairs.
List the preparations for engine removal.
Describe the general safety rules pertaining to engine removal, disassembly, and parts cleaning.
Explain the use of an engine lifting fixture or chain, and an engine crane.
Summarize how to properly disassemble an engine.
Describe typical inspections that should be made during engine disassembly and cleaning.
List various methods for cleaning engine parts.
Describe safety practices to follow when cleaning parts.
Correctly answer ASE certification test questions on engine removal, disassembly, and cleaning procedures.

Compare computer systems to the human body's nervous system.
Describe the input, processing, and output sections of a basic computer system.
Explain input sensor and output device classifications and operation.
Summarize computer system signal classifications.
Sketch a block diagram for a computer system.
Summarize where computers, control modules, sensors, and actuators are typically located.
Summarize the flow of data through a computer.
Explain how a computer uses sensor inputs to determine correct outputs.
Correctly answer ASE certification test questions that require a knowledge of automotive computer system fundamentals.

Discuss the purpose and operation of on-board diagnostic systems.
Explain the use of scan tools to simplify reading of trouble codes.
Compare OBD I and OBD II system capabilities and procedures.
Correctly answer ASE certification test questions concerning late-model on-board diagnostics and scan tool use.
Correctly answer ASE certification test questions on servicing computer system components.

Define the major parts of a fuel supply system.
Describe the operation of mechanical and electric fuel pumps.
Describe the construction and action of air filters.
Explain the tests used to diagnose problems with fuel pumps, fuel filters, and fuel lines.
State safety rules for working on fuel supply systems.
Correctly answer ASE certification test questions on fuel tanks, fuel pumps, fuel lines, fuel filters, and air filters.

List some of the possible advantages of gasoline injection.
Describe the classifications of gasoline injection.
Explain the operation of electronic throttle body gasoline injection.
Explain the operation of electronic multiport gasoline injection.
Summarize the operation of airflow-sensing, hydraulic-mechanical (continuous), and pressure-sensing gasoline injection systems.
Compare the various types of gasoline injection systems.
Correctly answer ASE certification test questions on gasoline injection systems..

Explain OBD II testing features used on late-model fuel injection systems.
Cite safety rules for injection system service.
Correctly answer ASE certification test questions about fuel injection system diagnosis, service, and repair.

Explain the operating principles of an automotive ignition system.
Compare contact point, electronic, and computer-controlled ignition systems.
Describe the function of major ignition system components.
Explain vacuum, centrifugal, and electronic ignition timing advance.
Sketch the primary and secondary sections of an ignition system.
Compare ignition coil, spark plug, and distributor design variations.
Describe the safety practices that must be followed when working with ignition systems.
Correctly answer ASE certification test questions that require a knowledge of ignition system fundamentals.
List the symptoms produced by faulty ignition system components.
Describe common tests used to find ignition system troubles.
Explain how to replace or repair ignition system parts.
Summarize contact point and pickup coil adjustments.

Define the fundamental terms relating to automotive emission control systems.
Explain the sources of air pollution.
Describe the operating principles of emission control systems.
Compare design differences in emission control systems.
Explain how a computer or engine control module can be used to operate emission control systems.
Summarize how OBD II systems use multiple oxygen sensors to check air-fuel mixture and catalytic converter efficiency.
Correctly answer ASE certification test questions that require a knowledge of emission control system operation and construction.

Describe the basic parts of an exhaust system.
Compare exhaust system design differences.
Explain the fundamental parts of a turbocharging system.
Describe the construction and operation of a turbocharger and waste gate.
Summarize the construction and operation of a supercharging system.
Demonstrate an understanding of safety procedures for working on exhaust systems, turbochargers, and superchargers.
Correctly answer ASE certification test questions on exhaust system, turbocharger, and supercharger operation and service.

List the most common engine performance ¬problems.
Describe the symptoms for common engine performance problems.
Explain typical causes of engine performance problems.
Use a systematic approach when diagnosing engine performance problems.
Correctly answer ASE certification test questions on problems affecting engine performance.
Explain the principles of an oscilloscope.
Summarize how to use waveforms to analyze the operation of sensors, actuators, ECU outputs, and other electrical-electronic devices.
Evaluate ignition system waveforms.
Summarize how to use an engine analyzer.

Describe the typical difference between a minor tune-up.
List the basic steps for an engine tune-up.
Explain service operations commonly performed during a tune-up.
List the safety precautions that should be remembered during a tune-up.
Correctly answer ASE certification test questions on engine tune-up and engine problem diagnosis.

Skills:

Check a car's fluid levels.
Locate fluid leaks.
Replace engine oil and filter.
Change automatic transmission fluid and filter.
Perform a grease job.
Inspect for general problems with hoses, belts, and other components.
Demonstrate safe practices while working with vehicle fluids.
Perform a combustion leak test and a system pressure test.
Check the major parts of a cooling system for proper operation.
Replace faulty cooling system components.
Drain, flush, and refill a cooling system.

Locate the data link connector on most makes and models of cars.
Activate on-board diagnostics and read trouble codes with and without a scan tool.
Use a trouble code chart in a service manual or code conversion by a scan tool.
Erase diagnostic trouble codes.
Perform a visual inspection of the engine, its sensors, actuators, and the systems they monitor and control.
Test sensors and their circuits.
Remove and replace sensors.
Test and replace actuators.
Remove and replace a computer.
Remove and replace a computer PROM.
Program an EEPROM.
Demonstrate safe working practices when servicing automotive computers.

Repair a fuel line or replace a fuel hose.
Locate and replace fuel filters in both gasoline and diesel fuel systems.
Diagnose typical gasoline injection system problems.
Test a fuel pressure regulator.
Test both electronic and continuous fuel injectors.
Use a service manual when making basic adjustments on gasoline injection systems.

Diagnose typical ignition system problems.
Adjust ignition timing.

Inspect and troubleshoot emission control systems.
Perform periodic service operations on emission control systems.
Test individual emission control components.
Replace or repair major emission control components.
Demonstrate and practice safe work procedures.

Perform exhaust system repairs.
Remove and replace a turbocharger and waste gate.

Use advanced diagnostic techniques to troubleshoot difficult problems.
Use scan tool snapshot and datastream values to find problems not tripping trouble codes.
Use a breakout box to measure circuit values.

I. ENGINE REPAIR

A. General Engine Diagnosis; Removal and Reinstallation (R & R)

Task Number and Description Priority Page #s

11. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 94–95
12. Identify and interpret engine concern; determine necessary action. P-1 137, 138–139, 871–896, 913–926
13. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins. P-1 85–95

14. Locate and interpret vehicle and major component identification numbers. P-1 86, 87, 269, 1072, 1110
15. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action. P-1 746, 786–788, 915
16. Diagnose engine noises and vibrations; determine necessary action. P-2 138, 139, 916
17. Diagnose the cause of excessive oil consumption, coolant consumption, unusual engine exhaust color and odor; determine necessary action. P-2 872–874, 892
18. Perform engine vacuum tests; determine necessary action. P-1 872–874, 892
19. Perform cylinder power balance tests; determine necessary action. P-2 895
20. Perform cylinder cranking and running compression tests; determine necessary action. P-1 916–920
21. Perform cylinder leakage tests; determine necessary action. P-1 920
22. Remove and reinstall engine in an OBDII or newer vehicle; reconnect all attaching components and restore the vehicle to running condition. P-2 931–937, 1011, 1012
23. Install engine covers using gaskets, seals, and sealers as required. P-1 119–124, 996–997, 1006–1007
24. Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads, and repair internal threads with thread insert. P-1 117–120
25. Inspect, remove, and replace engine mounts. P-2 925–926, 932–935

B. Cylinder Head and Valve Train Diagnosis and Repair

11. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specifications and procedures. P-1 115–117, 942, 943, 990, 991
12. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition. P-1 938, 939, 971–974
13. Inspect valve springs for squareness and free height comparison; determine necessary action. P-3 983, 984
14. Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine necessary action. P-3 984–986
15. Inspect valve guides for wear; check valve stem-to-guide clearance; determine necessary action. P-3 974–976
16. Inspect valves and valve seats; determine necessary action. P-3 974–983, 986
17. Check valve spring assembled height and valve stem height; determine necessary action. P-3 984
18. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action. P-2 989
19. Inspect valve lifters; determine necessary action.P-2 988, 989
20. Adjust valves (mechanical or hydraulic lifters).P-1 993–996
21. Inspect and replace camshaft and drive belt/chain (includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and variable valve timing components). P-1 983–986, 989–993
22. Inspect and/or measure camshaft for runout, journal wear, and lobe wear. P-2 987, 988
23. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine necessary action. P-2 988

C. Engine Block Assembly Diagnosis and Repair

11. Disassemble engine block; clean and prepare components for inspection and reassembly. P-1 940–945
12. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action. P-2 948–955, 973
13. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine necessary action. P-2 950, 951, 953, 954
14. Deglaze and clean cylinder walls. P-2 951–953
15. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action. P-3 988
16. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and

journal wear; check crankshaft position sensor reluctor ring (where applicable); determine necessary action. P-1 960–961, 963–964
17. Inspect main and connecting rod bearings for damage and wear; determine necessary action. P-2 958, 961–963, 965
18. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine necessary action. P-3 949, 954, 955
19. Inspect and measure piston skirts and ring lands; determine necessary action. P-2 941, 954–958, 964, 965
20. Remove and replace piston pin. P-3 956, 957, 958
21. Determine piston-to-bore clearance. P-2 955–956
22. Inspect, measure, and install piston rings.P-2 941, 955–956, 958–960
23. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance or silencer); inspect shaft(s) and support bearings for damage and wear; determine necessary action; reinstall and time. P-2 936, 954, 955, 987, 988
24. Remove, inspect, or replace crankshaft vibration damper (harmonic balancer). P-2 217 15.
25. Assemble engine block. P-1 120–124, 791–793, 962, 990–993, 996, 997, 1004–1007

D. Lubrication and Cooling Systems Diagnosis and Repair
1. Perform oil pressure tests; determine necessary action. P-1 789
2. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action. P-2 793–797
3. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; determine necessary action. P-1 747–749
4. Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment. P-1 548–550, 756–757
5. Inspect and replace engine cooling and heater system hoses. P-1 754, 755
6. Inspect, test, and replace thermostat and gasket/seal. P-1 751–754
7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required. P-1 132, 751, 754, 759–765
8. Inspect, remove and replace water pump.P-2 750, 751
9. Remove and replace radiator. P-2 756
10. Inspect, and test fans(s) (electrical or mechanical), fan clutch, fan shroud, and air dams. P-1 757, 758
11. Inspect auxiliary coolers; determine necessary action. P-3 779
12. Inspect, test, and replace oil temperature and pressure switches and sensors. P-2 798, 799
13. Perform oil and filter change. P-1 128–130
14. Identify causes of engine overheating.

VIII. ENGINE PERFORMANCE

A. General Engine Diagnosis
1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 94–95
2. Identify and interpret engine performance concern; determine necessary action. P-1 137–139, 859–866, 871–896, 913–926
3. Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins. P-1 85–95, 862
4. Locate and interpret vehicle and major component identification numbers. P-1 86, 87, 269, 1072, 1110
5. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action. P-2 914–916
6. Diagnose abnormal engine noise or vibration concerns; determine necessary action. P-3 138, 139, 859, 916
7. Diagnose abnormal exhaust color, odor, and sound; determine necessary action. P-2 431, 915, 916
NATEF Task List Correlation Chart 53
Task Number and Description Priority Page #s
8. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action. P-1 872–874

9. Perform cylinder power balance test; determine necessary action. P-2 895
10. Perform cylinder cranking and running compression tests; determine necessary action. P-1 906, 916–920
11. Perform cylinder leakage test; determine necessary action. P-1 920
12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action. P-1 107, 108, 282–294, 599, 880–896
13. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action. P-3 833–836, 837–840
14. Verify engine operating temperature; determine necessary action. P-1 752
15. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action. P-1 746–749, 755, 756, 759–761
16. Verify correct camshaft timing.P-1 1001–1004, 1009

B. Computerized Engine Controls Diagnosis and Repair
1. Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable. P-1 268–277
2. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data. P-1 268–277, 373, 374, 384–391, 622, 846–849
3. Diagnose emissions or driveability concerns without stored diagnostic trouble codes; determine necessary action. P-1 283–294, 373, 374, 384–391, 622, 846–849
4. Check for module communication (including CAN/BUS systems)errors using a scan tool. P-2 284
5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO); perform necessary action. P-1 282–294, 384–388, 622
6. Access and use service information to perform step-by-step diagnosis. P-1 85–95, 269, 277
7. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems); determine necessary action. P-3 683–687, 1110–1113, 1493,1544, 1545
8. Perform active tests of actuators using a scan tool; determine necessary action. P-1 273, 875

C. Ignition System Diagnosis and Repair
1. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action. P-1 595, 596, 621, 831, 863–866, 905
2. Inspect and test ignition primary and secondary circuit wiring and solid-state components; test ignition coil(s); perform necessary action. P-1 600–602, 618–619
3. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action. P-1 618
4. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary. P-2 291–294

D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action. P-1 371–392, 403–408, 430–433, 863–867
2. Check fuel for contaminants and quality; determine necessary action. P-2 308–309
3. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action. P-1 329–334
4. Replace fuel filters. P-2 135, 329, 330
5. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air. P-2 135, 334,377, 378, 391, 991–993
6. Inspect and test fuel injectors. P-1 376–381
7. Verify idle control operation. P-1 381–383, 407–408, 432–437

8. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.
9. P-1 450–455
10. Perform exhaust system backpressure test; determine necessary action. P-1 449, 847
11. Test the operation of turbocharger/supercharger systems; determine necessary action. P-3 450–458

E. Emissions Control Systems Diagnosis and Repair
1. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action. P-2 798, 799, 804–809, 831–853
2. Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action. P-2 806–810, 842, 843
3. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action. P-1 811–815, 845, 846
4. Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters and hoses; perform necessary action. P-1 811–815, 845, 846
5. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action. P-2 811–815, 845, 846
6. Diagnose emissions and driveability concerns caused by the secondary air injection and catalytic converter systems; determine necessary action. P-2 815–821, 846–849
7. Inspect and test mechanical components of secondary air injection systems; perform necessary action.
8. P-3 846, 847
9. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action. P-3 846, 847
10. Inspect and test catalytic converter efficiency. P-1 847, 848
11. Diagnose emissions and driveability concerns caused by the evaporative emissions control system; determine necessary action. P-1 808–811, 826, 843, 844
12. Inspect and test components and hoses of the evaporative emissions control system; perform necessary action. P-1 843, 844
13. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action. P-1 831, 832

F. Engine Related Service
1. Adjust valves on engines with mechanical or hydraulic lifters. P-1 993–996
2. Remove and replace timing belt; verify correct camshaft timing. P-1 1009–1011
3. Remove and replace thermostat and gasket/seal. P-1 751–753
4. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action. P-1 757–758
5. Perform common fastener and thread repairs, to include: remove broken bolt, restore internal and external threads, and repair internal threads with a threaded insert. P-1 117–120
6. Perform engine oil and filter change.P-1 129–130
7. Identify hybrid vehicle internal combustion engine service precautions.

Remediation:

Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:

Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.

Working on skills for SkillsUSA, Lehigh Valley Dealers Association, and/or Northampton Community College competitions

Special Adaptations:

Extended Time (assignments and/or testing)
Preferential Seating
Directions/Comprehension Check (frequent checks for understanding)
Study Guide
Directions and/or Tests Read Aloud
Adapted Tests and/or Assignments
Use of Calculator
Taking Tests in Alternate Setting (or if requested)
Verbal/Gestural Redirection (prompts to remain on task)
Drill and Practice (Repetition of Material)
Small Group Instruction
Provide Visual Model to Accompany Verbal Directions (Written/Oral Directions)
Use of Computer (Access to)
Positive Reinforcement
Have Student Repeat Directions
Wait Time
Access to School Counselor
Use of Highlighter/Highlighted Text
Provide Frequent Feedback
Provide Frequent Breaks
Regular Notebook Check
Variety of Assessment Methods
Highly Structured Classroom
Syllabus for Major Projects
Limited, Short Directions
Grading Rubric
Communication Regarding Behavior & Consequences (PBS)
Clear Language for Directions
Provide Opportunities to Retest
Frequent Review Sessions
Use a variety of Modalities when Introducing Skills/Concepts
Allow Oral Answers for Testing
Cue for Oral Response
De-Escalation Opportunities
Daily Classwork Check
Encourage Student to Check Work Before Turning In
Opportunities for Repeated Practice of MATH Skills
Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage
Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Safety:

Student Must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.

Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards.
Know and follow the established safety rules at all times.

Assessment:

Written test
Activity worksheets
Workbooks
Quizzes
Pre/Post Tests
Essays
Summaries
Time Cards
Writing Activities
Video/DVD Worksheets
Rubrics
Check Lists
Debates
Oral Presentation
Diagrams
Individual Projects
Group Projects
Research Papers
Current Events

Resources/Equipment:

Duffy, J.E.(2009).Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Module 2 Lessons 1-15 Automotive Engines and Module 4 Lessons 1-14 Engine Performance and Computer Fundamentals Modern Technology Service Technician (MAST) On-Line Training. (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Duffy, J.E.(2009). Textbook, Workbook and Student Job Manual - Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodheart-Willcox Company, Inc.

Snap-on Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions

Web base training software: ShopKey 5 Service Information
Automotive Technology Workbooks
MSDS hand book
NATEF Task Assessment Worksheet
Computers
Textbook:
Web base training - Service Information (ShopKey 5)
Common hand tools:
Wrenches--open end, box end, and combination
Sockets--shallow, deep, 6-point, 12-point, standard, and impact
Drive size--1/4 inch, 3/8 inch, 1/2 inch, and 3/4 inch
Socket accessories--speed handle, extensions 3 to 36 inches long, universals, flex handle, and T bar
Screwdrivers--flat blade (standard), Phillips, clutch, and Torx
Pliers--slip joint, water pump, diagonal cutting, vise grip, snap ring, needle nose, battery, and duck bill
Punches--taper, pin, and center
Hammers--ball peen, soft face, and brass
Coolant Pressure Test Kit
Electronic Stethoscope
Fuel Pressure Line Disconnect Kit
Micrometer Measuring Tool
Caliber Measuring Tool
Dial Indicator Measuring Tool
Above the ground vehicle lifts
Drive-On lifts with hydraulic jacks
Tripod Jack Stands
Screw Jack Stand
Standard Jack Stand
Four 2 ½ ton Floor Jacks

Torque Wrenches: 3/8 – ½ inch Drive
Inch Pound Torque wrench
Two Electric Reversible Drills
½ Inch Drive Impact Wrench – battery operated
½ Inch Drive Impact Air Wrench
3/8 Drive Air Impact Ratchet
¼ Air Impact Ratchet
Oil Caddy
Drain pans and funnels
School –Owned Shop Vehicles – 2002 Chevy S-10 Pick-up Truck, 1999 Chevy Cavaliers (2), 1995 Pontiac Bonneville, 1991 Honda Civic, 1991 Chevy Lumina, 1997 Jeep Cherokee, 2001 Chevy Astro Van, 1991 Ford Ranger Pick-up Truck, 1991 Buick Regal, 1991 Chevy Corsica, 1998 Subaru Legacy, 1998 Mitsubishi Mirage
Hyperlinks:

www.g-wonlinetextbooks.com

www.sp2.org

www.library.alldatapro.com

Monroe Career & Technical Institute
Course Name: Automotive Technology 2016

Unit Name: PA1000 – AUTOMATIC TRANSMISSION AND TRANSAXLE

Unit Number: PA1000

Dates: Spring 2016 **Hours:** 8.00

Last Edited By: Automotive Technology (05-12-2016)

Unit Description / Objectives:

Students will be able to identify, troubleshoot and demonstrate knowledge related to service information regarding transmission and transaxle maintenance.

Tasks:

PA1001 - Research applicable vehicle and service information, fluid type, vehicle service history, service precautions, and technical service bulletins.

PA1002 - Check fluid level in a transmission or a transaxle equipped with a dip-stick.

PA1003 - Check fluid level in a transmission or a transaxle not equipped with a dip-stick.

PA1004 - Drain and replace fluid and filter(s).

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.

Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.

Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.

CRAFT & STRUCTURE GRADES 9-10-11-12

Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key terms, and other domain specific words.

Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.

Standard CC.3.5.9-10.F / Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure...and Analyze the structure of the relationships among concepts in a text.

INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).

Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.

Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.

INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12
Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.

Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.

Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.

RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Focus Anchor/Standard #2:

- Pennsylvania Core Standards for Writing for Technical Subjects Standard 3.6

Supporting Anchor/Standards:

TEXT TYPES AND PURPOSE GRADES 9-10-11-12
Standard CC.3.6.9-10.A Standard CC.3.6.11-12.A Write arguments focused on discipline specific content.

Standard CC.3.6.9-10.B Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes, etc.

PRODUCTION & DISTRIBUTION OF WRITING GRADES 9-10-11-12
Standard CC.3.6.9-10.C Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience.

Standard CC.3.6.9-10 D Standard CC.3.6.11-12.D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

Standard CC.3.6.9-10.E Standard CC.3.6.11-12.E. Use technology, including the internet, to produce, publish, and update individual or shared writing products.

RESEARCH GRADES 9-10-11-12
Standard CC.3.6.9-10.F Standard CC.3.6.11-12.F Conduct short and more sustained research to answer a question or solve a problem.

Standard CC.3.6.9-10.G. Standard CC.3.6.11-12.G Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation.

Standard CC.3.6.9-10.H. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.

RANGE OF WRITING GRADES 9-10-11-12
Standard CC.3.5.9-10.I & Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences...etc.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.

Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

ALGEBRA
Standard 2.2.HS.C.9 Prove the Pythagorean identity and use it to calculate trigonometric ratios.

GEOMETRY
Standard 2.3.HS.A.7 Apply trigonometric ratios to solve problems involving right triangles.
Standard 2.3.HS.A.3 Verify and apply geometric theorems as they relate to geometric figures.
Standard 2.3.HS.A.13 Analyze relationships between two dimensional and three dimensional objects.

Instructional Activities:

Knowledge:

Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
List all the parts of the cylinder head, engine oiling system, and cooling system.
Analyze the purposes of valve guides, seals, seats, springs, keepers, retainers, rotators.
Identify the parts in the valve operating mechanism including lifters, pushrods, rocker-arms, camshaft, oil gauges.
Explain the importance of vehicle maintenance.
Correctly answer ASE certification test questions on fluid service and vehicle maintenance.

Summarize the functions of a cooling system.
Explain the operation and construction of major cooling system components.
Compare cooling system design variations.
Explain the importance of antifreeze.
Discuss safety procedures to follow when working with cooling systems.
Correctly answer ASE certification test questions on cooling system construction and operation.

List common cooling system problems and their symptoms.
Describe the most common causes of system leakage, overheating, and overcooling.
Describe safe working practices to use when testing, maintaining, or repairing a cooling system.
Correctly answer ASE certification test questions on cooling system troubleshooting and repair.

Explain why proper diagnosis methods are important to engine repair.
List common symptoms of engine mechanical problems.
Discuss how to find abnormal engine noises.
Summarize procedures for gasoline and diesel engine compression testing.
Explain when and how to do a wet compression test.
Summarize common causes of engine mechanical problems.
Discuss safety practices to follow while performing engine inspections.
Correctly answer ASE certification test questions on engine mechanical problems.

Determine if engine removal is needed to make specific engine repairs.
List the preparations for engine removal.
Describe the general safety rules pertaining to engine removal, disassembly, and parts cleaning.
Explain the use of an engine lifting fixture or chain, and an engine crane.
Summarize how to properly disassemble an engine.
Describe typical inspections that should be made during engine disassembly and cleaning.
List various methods for cleaning engine parts.
Describe safety practices to follow when cleaning parts.
Correctly answer ASE certification test questions on engine removal, disassembly, and cleaning procedures.

Compare computer systems to the human body's nervous system.
Describe the input, processing, and output sections of a basic computer system.
Explain input sensor and output device classifications and operation.
Summarize computer system signal classifications.
Sketch a block diagram for a computer system.
Summarize where computers, control modules, sensors, and actuators are typically located.
Summarize the flow of data through a computer.
Explain how a computer uses sensor inputs to determine correct outputs.
Correctly answer ASE certification test questions that require a knowledge of automotive computer system fundamentals.

Discuss the purpose and operation of on-board diagnostic systems.
Explain the use of scan tools to simplify reading of trouble codes.
Compare OBD I and OBD II system capabilities and procedures.
Correctly answer ASE certification test questions concerning late-model on-board diagnostics and scan tool use.
Correctly answer ASE certification test questions on servicing computer system components.

Define the major parts of a fuel supply system.
Describe the operation of mechanical and electric fuel pumps.
Describe the construction and action of air filters.
Explain the tests used to diagnose problems with fuel pumps, fuel filters, and fuel lines.
State safety rules for working on fuel supply systems.
Correctly answer ASE certification test questions on fuel tanks, fuel pumps, fuel lines, fuel filters, and air filters.

List some of the possible advantages of gasoline injection.
Describe the classifications of gasoline injection.
Explain the operation of electronic throttle body gasoline injection.
Explain the operation of electronic multiport gasoline injection.
Summarize the operation of airflow-sensing, hydraulic-mechanical (continuous), and pressure-sensing gasoline injection systems.
Compare the various types of gasoline injection systems.
Correctly answer ASE certification test questions on gasoline injection systems..
Explain OBD II testing features used on late-model fuel injection systems.
Cite safety rules for injection system service.
Correctly answer ASE certification test questions about fuel injection system diagnosis, service, and repair.

Explain the operating principles of an automotive ignition system.
Compare contact point, electronic, and computer-controlled ignition systems.
Describe the function of major ignition system components.
Explain vacuum, centrifugal, and electronic ignition timing advance.
Sketch the primary and secondary sections of an ignition system.
Compare ignition coil, spark plug, and distributor design variations.
Describe the safety practices that must be followed when working with ignition systems.
Correctly answer ASE certification test questions that require a knowledge of ignition system fundamentals.
List the symptoms produced by faulty ignition system components.
Describe common tests used to find ignition system troubles.
Explain how to replace or repair ignition system parts.
Summarize contact point and pickup coil adjustments.

Define the fundamental terms relating to automotive emission control systems.
Explain the sources of air pollution.
Describe the operating principles of emission control systems.
Compare design differences in emission control systems.
Explain how a computer or engine control module can be used to operate emission control systems.
Summarize how OBD II systems use multiple oxygen sensors to check air-fuel mixture and catalytic converter efficiency.
Correctly answer ASE certification test questions that require a knowledge of emission control system operation and construction.

Describe the basic parts of an exhaust system.
Compare exhaust system design differences.
Explain the fundamental parts of a turbocharging system.
Describe the construction and operation of a turbocharger and waste gate.
Summarize the construction and operation of a supercharging system.
Demonstrate an understanding of safety procedures for working on exhaust systems, turbochargers, and superchargers.
Correctly answer ASE certification test questions on exhaust system, turbocharger, and supercharger operation and service.

List the most common engine performance ¬problems.
Describe the symptoms for common engine performance problems.
Explain typical causes of engine performance problems.
Use a systematic approach when diagnosing engine performance problems.
Correctly answer ASE certification test questions on problems affecting engine performance.
Explain the principles of an oscilloscope.
Summarize how to use waveforms to analyze the operation of sensors, actuators, ECU outputs, and other electrical-electronic devices.
Evaluate ignition system waveforms.
Summarize how to use an engine analyzer.

Describe the typical difference between a minor tune-up.
List the basic steps for an engine tune-up.
Explain service operations commonly performed during a tune-up.
List the safety precautions that should be remembered during a tune-up.
Correctly answer ASE certification test questions on engine tune-up and engine problem diagnosis.

Skills:

Check a car's fluid levels.
Locate fluid leaks.
Replace engine oil and filter.
Change automatic transmission fluid and filter.
Perform a grease job.
Inspect for general problems with hoses, belts, and other components.

Demonstrate safe practices while working with vehicle fluids.
Perform a combustion leak test and a system pressure test.
Check the major parts of a cooling system for proper operation.
Replace faulty cooling system components.
Drain, flush, and refill a cooling system.

Locate the data link connector on most makes and models of cars.
Activate on-board diagnostics and read trouble codes with and without a scan tool.
Use a trouble code chart in a service manual or code conversion by a scan tool.
Erase diagnostic trouble codes.
Perform a visual inspection of the engine, its sensors, actuators, and the systems they monitor and control.
Test sensors and their circuits.
Remove and replace sensors.
Test and replace actuators.
Remove and replace a computer.
Remove and replace a computer PROM.
Program an EEPROM.
Demonstrate safe working practices when servicing automotive computers.

Repair a fuel line or replace a fuel hose.
Locate and replace fuel filters in both gasoline and diesel fuel systems.
Diagnose typical gasoline injection system problems.
Test a fuel pressure regulator.
Test both electronic and continuous fuel injectors.
Use a service manual when making basic adjustments on gasoline injection systems.

Diagnose typical ignition system problems.
Adjust ignition timing.

Inspect and troubleshoot emission control systems.
Perform periodic service operations on emission control systems.
Test individual emission control components.
Replace or repair major emission control components.
Demonstrate and practice safe work procedures.

Perform exhaust system repairs.
Remove and replace a turbocharger and waste gate.

Use advanced diagnostic techniques to troubleshoot difficult problems.
Use scan tool snapshot and datastream values to find problems not tripping trouble codes.
Use a breakout box to measure circuit values.

I. ENGINE REPAIR

A. General Engine Diagnosis; Removal and Reinstallation (R & R)

Task Number and Description Priority Page #s

11. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 94–95
12. Identify and interpret engine concern; determine necessary action. P-1 137, 138–139, 871–896, 913–926
13. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins. P-1 85–95
14. Locate and interpret vehicle and major component identification numbers. P-1 86, 87, 269, 1072, 1110
15. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action. P-1 746, 786–788, 915
16. Diagnose engine noises and vibrations; determine necessary action. P-2 138, 139, 916
17. Diagnose the cause of excessive oil consumption, coolant consumption, unusual engine exhaust color and odor; determine necessary action. P-2 872–874, 892

18. Perform engine vacuum tests; determine necessary action. P-1 872–874, 892
19. Perform cylinder power balance tests; determine necessary action.P-2 895
10. Perform cylinder cranking and running compression tests; determine necessary action. P-1 916–920
11. Perform cylinder leakage tests; determine necessary action P-1 920
12. Remove and reinstall engine in an OBDII or newer vehicle; reconnect all attaching components and restore the vehicle to running condition. P-2 931–937, 1011, 1012
13. Install engine covers using gaskets, seals, and sealers as required.P-1 119–124, 996–997, 1006–1007
14. Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads, and repair internal threads with thread insert. P-1 117–120
15. Inspect, remove, and replace engine mounts.P-2 925–926, 932–935

B. Cylinder Head and Valve Train Diagnosis and Repair
1. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specifications and procedures.P-1 115–117, 942, 943, 990, 991
2. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition. P-1 938, 939, 971–974
3. Inspect valve springs for squareness and free height comparison; determine necessary action. P-3 983, 984
4. Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine necessary action. P-3 984–986
5. Inspect valve guides for wear; check valve stem-to-guide clearance; determine necessary action. P-3 974–976
6. Inspect valves and valve seats; determine necessary action.P-3 974–983, 986
7. Check valve spring assembled height and valve stem height; determine necessary action. P-3 984
8. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action. P-2 989
9. Inspect valve lifters; determine necessary action.P-2 988, 989
10. Adjust valves (mechanical or hydraulic lifters).P-1 993–996
11. Inspect and replace camshaft and drive belt/chain (includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and variable valve timing components). P-1 983–986, 989–993
12. Inspect and/or measure camshaft for runout, journal wear, and lobe wear. P-2 987, 988
13. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine necessary action. P-2 988

C. Engine Block Assembly Diagnosis and Repair
1. Disassemble engine block; clean and prepare components for inspection and reassembly. P-1 940–945
2. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action. P-2 948–955, 973
3. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine necessary action. P-2 950, 951, 953, 954
4. Deglaze and clean cylinder walls. P-2 951–953
5. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action. P-3 988
6. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and journal wear; check crankshaft position sensor reluctor ring (where applicable); determine necessary action. P-1 960–961, 963–964
7. Inspect main and connecting rod bearings for damage and wear; determine necessary action. P-2 958, 961–963, 965
8. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine necessary action. P-3 949, 954, 955
9. Inspect and measure piston skirts and ring lands; determine necessary action. P-2 941, 954–958, 964, 965

10. Remove and replace piston pin. P-3 956, 957, 958
11. Determine piston-to-bore clearance. P-2 955–956
12. Inspect, measure, and install piston rings. P-2 941, 955–956, 958–960
13. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance or silencer); inspect shaft(s) and support bearings for damage and wear; determine necessary action; reinstall and time. P-2 936, 954, 955, 987, 988
14. Remove, inspect, or replace crankshaft vibration damper (harmonic balancer). P-2 217
15. Assemble engine block. P-1 120–124, 791–793, 962, 990–993, 996, 997, 1004–1007

D. Lubrication and Cooling Systems Diagnosis and Repair

1. Perform oil pressure tests; determine necessary action. P-1 789
2. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action. P-2 793–797
3. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; determine necessary action. P-1 747–749
4. Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment. P-1 548–550, 756–757
5. Inspect and replace engine cooling and heater system hoses. P-1 754, 755
6. Inspect, test, and replace thermostat and gasket/seal. P-1 751–754
7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required. P-1 132, 751, 754, 759–765
8. Inspect, remove and replace water pump. P-2 750, 751
9. Remove and replace radiator. P-2 756
10. Inspect, and test fans(s) (electrical or mechanical), fan clutch, fan shroud, and air dams. P-1 757, 758
11. Inspect auxiliary coolers; determine necessary action. P-3 779
12. Inspect, test, and replace oil temperature and pressure switches and sensors. P-2 798, 799
13. Perform oil and filter change.P-1 128–130
14. Identify causes of engine overheating.

VIII. ENGINE PERFORMANCE

A. General Engine Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 94–95
2. Identify and interpret engine performance concern; determine necessary action. P-1 137–139, 859–866, 871–896, 913–926
3. Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins. P-1 85–95, 862
4. Locate and interpret vehicle and major component identification numbers. P-1 86, 87, 269, 1072, 1110
5. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action. P-2 914–916
6. Diagnose abnormal engine noise or vibration concerns; determine necessary action. P-3 138, 139, 859, 916
7. Diagnose abnormal exhaust color, odor, and sound; determine necessary action. P-2 431, 915, 916
   NATEF Task List Correlation Chart 53
   Task Number and Description Priority Page #s
8. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action. P-1 872–874
9. Perform cylinder power balance test; determine necessary action. P-2 895
10. Perform cylinder cranking and running compression tests; determine necessary action. P-1 906, 916–920
11. Perform cylinder leakage test; determine necessary action. P-1 920
12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action. P-1 107, 108, 282–294, 599, 880–896

13. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action. P-3 833–836, 837–840
14. Verify engine operating temperature; determine necessary action.P-1 752
15. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action. P-1 746–749, 755, 756, 759–761
16. Verify correct camshaft timing. P-1 1001–1004, 1009

B. Computerized Engine Controls Diagnosis and Repair

1. Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable. P-1 268–277
2. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data. P-1 268–277, 373, 374, 384–391, 622, 846–849
3. Diagnose emissions or driveability concerns without stored diagnostic trouble codes; determine necessary action. P-1 283–294, 373, 374, 384–391, 622, 846–849
4. Check for module communication (including CAN/BUS systems) errors using a scan tool. P-2 284
5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO); perform necessary action. P-1 282–294, 384–388, 622
6. Access and use service information to perform step-by-step diagnosis. P-1 85–95, 269, 277
7. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems); determine necessary action. P-3 683–687, 1110–1113, 1493,1544, 1545
8. Perform active tests of actuators using a scan tool; determine necessary action. P-1 273, 875

C. Ignition System Diagnosis and Repair

1. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action. P-1 595, 596, 621, 831, 863–866, 905
2. Inspect and test ignition primary and secondary circuit wiring and solid-state components; test ignition coil(s); perform necessary action. P-1 600–602, 618–619
3. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action. P-1 618
4. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary. P-2 291–294

D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair

1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action. P-1 371–392, 403–408, 430–433, 863–867
2. Check fuel for contaminants and quality; determine necessary action. P-2 308–3093. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action. P-1 329–334
3. Replace fuel filters.P-2 135, 329, 330
4. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air. P-2 135, 334,377, 378, 391, 991–993
5. Inspect and test fuel injectors. P-1 376–381
6. Verify idle control operation. P-1 381–383, 407–408, 432–437
7. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action. P-1 450–455
8. Perform exhaust system backpressure test; determine necessary action. P-1 449, 847
9. Test the operation of turbocharger/supercharger systems; determine necessary action. P-3 450–458

E. Emissions Control Systems Diagnosis and Repair
1. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action. P-2 798, 799, 804–809, 831–853
2. Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action. P-2 806–810, 842, 843
3. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action. P-1 811–815, 845, 846
4. Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters and hoses; perform necessary action. P-1 811–815, 845, 846
5. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action. P-2 811–815, 845, 846
6. Diagnose emissions and driveability concerns caused by the secondary air injection and catalytic converter systems; determine necessary action. P-2 815–821, 846–849
7. Inspect and test mechanical components of secondary air injection systems; perform necessary action. P-3 846, 847
8. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action. P-3 846, 847
9. Inspect and test catalytic converter efficiency.P-1 847, 848
10. Diagnose emissions and driveability concerns caused by the evaporative emissions control system; determine necessary action. P-1 808–811, 826, 843, 844
11. Inspect and test components and hoses of the evaporative emissions control system; perform necessary action. P-1 843, 844
12. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action. P-1 831, 832

F. Engine Related Service
1. Adjust valves on engines with mechanical or hydraulic lifters. P-1 993–996
2. Remove and replace timing belt; verify correct camshaft timing. P-1 1009–1011
3. Remove and replace thermostat and gasket/seal. P-1 751–753
4. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action. P-1 757–758
5. Perform common fastener and thread repairs, to include: remove broken bolt, restore internal and external threads, and repair internal threads with a threaded insert. P-1 117–120
6. Perform engine oil and filter change.P-1 129–130
7. Identify hybrid vehicle internal combustion engine service precautions.

Remediation:

Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:

Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.
Working on skills for SkillsUSA, Lehigh Valley Dealers Association, and/or Northampton Community College competitions

Special Adaptations:

Extended Time (assignments and/or testing)
Preferential Seating
Directions/Comprehension Check (frequent checks for understanding)
Study Guide
Directions and/or Tests Read Aloud
Adapted Tests and/or Assignments
Use of Calculator
Taking Tests in Alternate Setting (or if requested)
Verbal/Gestural Redirection (prompts to remain on task)
Drill and Practice (Repetition of Material)
Small Group Instruction
Provide Visual Model to Accompany Verbal Directions (Written/Oral Directions)
Use of Computer (Access to)
Positive Reinforcement
Have Student Repeat Directions
Wait Time
Access to School Counselor
Use of Highlighter/Highlighted Text
Provide Frequent Feedback
Provide Frequent Breaks
Regular Notebook Check
Variety of Assessment Methods
Highly Structured Classroom
Syllabus for Major Projects
Limited, Short Directions
Grading Rubric
Communication Regarding Behavior & Consequences (PBS)
Clear Language for Directions
Provide Opportunities to Retest
Frequent Review Sessions
Use a variety of Modalities when Introducing Skills/Concepts
Allow Oral Answers for Testing
Cue for Oral Response
De-Escalation Opportunities
Daily Classwork Check
Encourage Student to Check Work Before Turning In
Opportunities for Repeated Practice of MATH Skills
Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage
Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Safety:

Student Must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards.
Know and follow the established safety rules at all times.

Assessment:

- Written test
- Activity worksheets
- Workbooks
- Quizzes
- Pre/Post Tests
- Essays
- Summaries
- Time Cards
- Writing Activities
- Video/DVD Worksheets
- Rubrics
- Check Lists
- Debates
- Oral Presentation
- Diagrams
- Individual Projects
- Group Projects
- Research Papers
- Current Events

Resources/Equipment:

Duffy, J.E.(2009).Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Module 2 Lessons 1-15 Automotive Engines and Module 4 Lessons 1-14 Engine Performance and Computer Fundamentals Modern Technology Service Technician (MAST) On-Line Training. (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Duffy, J.E.(2009). Textbook,Workbook and Student Job Manual - Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodheart-Willcox Company, Inc.

Snap-on Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions

Web base training software: ShopKey 5 Service Information
Automotive Technology Workbooks
MSDS hand book
NATEF Task Assessment Worksheet
Computers
Textbook:
Web base training - Service Information (ShopKey 5)
Common hand tools:
Wrenches--open end, box end, and combination
Sockets--shallow, deep, 6-point, 12-point, standard, and impact
Drive size--1/4 inch, 3/8 inch, 1/2 inch, and 3/4 inch
Socket accessories--speed handle, extensions 3 to 36 inches long, universals, flex handle, and T bar
Screwdrivers--flat blade (standard), Phillips, clutch, and Torx
Pliers--slip joint, water pump, diagonal cutting, vise grip, snap ring, needle nose, battery, and duck bill
Punches--taper, pin, and center
Hammers--ball peen, soft face, and brass
Coolant Pressure Test Kit

Electronic Stethoscope
Fuel Pressure Line Disconnect Kit
Micrometer Measuring Tool
Caliber Measuring Tool
Dial Indicator Measuring Tool
Above the ground vehicle lifts
Drive-On lifts with hydraulic jacks
Tripod Jack Stands
Screw Jack Stand
Standard Jack Stand
Four 2 ½ ton Floor Jacks
Torque Wrenches: 3/8 – ½ inch Drive
Inch Pound Torque wrench
Two Electric Reversible Drills
½ Inch Drive Impact Wrench – battery operated
½ Inch Drive Impact Air Wrench
3/8 Drive Air Impact Ratchet
¼ Air Impact Ratchet
Oil Caddy
Drain pans and funnels

School –Owned Shop Vehicles – 2002 Chevy S-10 Pick-up Truck, 1999 Chevy Cavaliers (2), 1995 Pontiac Bonneville, 1991 Honda Civic, 1991 Chevy Lumina, 1997 Jeep Cherokee, 2001 Chevy Astro Van, 1991 Ford Ranger Pick-up Truck, 1991 Buick Regal, 1991 Chevy Corsica, 1998 Subaru Legacy, 1998 Mitsubishi Mirage
Hyperlinks:
www.g-wonlinetextbooks.com
www.sp2.org
www.library.alldatapro.com

Unit Name: 1100 MANUAL DRIVE TRAIN AND AXLES

Number: 1100 **Hours:** 12.00

Dates: Spring 2016

Last Edited By: Automotive Technology (05-12-2016)

Description / Objectives:

Students will be able to identify, troubleshoot and demonstrate knowledge related to service information regarding transmission and transaxle maintenance.

Tasks:

1101 Research applicable vehicle and service information, fluid type, vehicle service history, service precautions, and technical service bulletins.
1102 Drain and refill manual transmission/transaxle and final drive unit.
1103 Check and adjust clutch master cylinder fluid level.
1104 Check for system leaks.
1105 Check and adjust differential housing fluid level.
1106 Drain and refill differential housing.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.
Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.
Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.
CRAFT & STRUCTURE GRADES 9-10-11-12
Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key terms, and other domain specific words.
Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.
Standard CC.3.5.9-10.F / Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure...and Analyze the structure of the relationships among concepts in a text.
INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).
Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.
Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.
INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12
Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information

presented in diverse formats...to solve a problem.
Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.
Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.
RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Focus Anchor/Standard #2:

- Pennsylvania Core Standards for Writing for Technical Subjects Standard 3.6

Supporting Anchor/Standards:

TEXT TYPES AND PURPOSE GRADES 9-10-11-12
Standard CC.3.6.9-10.A Standard CC.3.6.11-12.A Write arguments focused on discipline specific content.
Standard CC.3.6.9-10.B Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes, etc.
PRODUCTION & DISTRIBUTION OF WRITING GRADES 9-10-11-12
Standard CC.3.6.9-10.C Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience.
Standard CC.3.6.9-10 D Standard CC.3.6.11-12.D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
Standard CC.3.6.9-10.E Standard CC.3.6.11-12.E. Use technology, including the internet, to produce, publish, and update individual or shared writing products.
RESEARCH GRADES 9-10-11-12
Standard CC.3.6.9-10.F Standard CC.3.6.11-12.F Conduct short and more sustained research to answer a question or solve a problem.
Standard CC.3.6.9-10.G. Standard CC.3.6.11-12.G Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation.
Standard CC.3.6.9-10.H. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.
RANGE OF WRITING GRADES 9-10-11-12
Standard CC.3.5.9-10.I & Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences...etc.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.
Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.
Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

ALGEBRA
Standard 2.2.HS.C.9 Prove the Pythagorean identity and use it to calculate trigonometric ratios.
GEOMETRY
Standard 2.3.HS.A.7 Apply trigonometric ratios to solve problems involving right triangles.
Standard 2.3.HS.A.3 Verify and apply geometric theorems as they relate to geometric figures.
Standard 2.3.HS.A.13 Analyze relationships between two dimensional and three dimensional objects.

Instructional Activities:

Knowledge:
Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
List all the parts of the cylinder head, engine oiling system, and cooling system.
Analyze the purposes of valve guides, seals, seats, springs, keepers, retainers, rotators.
Identify the parts in the valve operating mechanism including lifters, pushrods, rocker-arms, camshaft, oil gauges.
Explain the importance of vehicle maintenance.
Correctly answer ASE certification test questions on fluid service and vehicle maintenance.

Summarize the functions of a cooling system.
Explain the operation and construction of major cooling system components.
Compare cooling system design variations.
Explain the importance of antifreeze.
Discuss safety procedures to follow when working with cooling systems.
Correctly answer ASE certification test questions on cooling system construction and operation.

List common cooling system problems and their symptoms.
Describe the most common causes of system leakage, overheating, and overcooling.
Describe safe working practices to use when testing, maintaining, or repairing a cooling system.
Correctly answer ASE certification test questions on cooling system troubleshooting and repair.

Explain why proper diagnosis methods are important to engine repair.
List common symptoms of engine mechanical problems.
Discuss how to find abnormal engine noises.
Summarize procedures for gasoline and diesel engine compression testing.
Explain when and how to do a wet compression test.
Summarize common causes of engine mechanical problems.
Discuss safety practices to follow while performing engine inspections.
Correctly answer ASE certification test questions on engine mechanical problems.

Determine if engine removal is needed to make specific engine repairs.
List the preparations for engine removal.
Describe the general safety rules pertaining to engine removal, disassembly, and parts cleaning.
Explain the use of an engine lifting fixture or chain, and an engine crane.
Summarize how to properly disassemble an engine.
Describe typical inspections that should be made during engine disassembly and cleaning.
List various methods for cleaning engine parts.

Describe safety practices to follow when cleaning parts.
Correctly answer ASE certification test questions on engine removal, disassembly, and cleaning procedures.

Compare computer systems to the human body's nervous system.
Describe the input, processing, and output sections of a basic computer system.
Explain input sensor and output device classifications and operation.
Summarize computer system signal classifications.
Sketch a block diagram for a computer system.
Summarize where computers, control modules, sensors, and actuators are typically located.
Summarize the flow of data through a computer.
Explain how a computer uses sensor inputs to determine correct outputs.
Correctly answer ASE certification test questions that require a knowledge of automotive computer system fundamentals.

Discuss the purpose and operation of on-board diagnostic systems.
Explain the use of scan tools to simplify reading of trouble codes.
Compare OBD I and OBD II system capabilities and procedures.
Correctly answer ASE certification test questions concerning late-model on-board diagnostics and scan tool use.
Correctly answer ASE certification test questions on servicing computer system components.

Define the major parts of a fuel supply system.
Describe the operation of mechanical and electric fuel pumps.
Describe the construction and action of air filters.
Explain the tests used to diagnose problems with fuel pumps, fuel filters, and fuel lines.
State safety rules for working on fuel supply systems.
Correctly answer ASE certification test questions on fuel tanks, fuel pumps, fuel lines, fuel filters, and air filters.

List some of the possible advantages of gasoline injection.
Describe the classifications of gasoline injection.
Explain the operation of electronic throttle body gasoline injection.
Explain the operation of electronic multiport gasoline injection.
Summarize the operation of airflow-sensing, hydraulic-mechanical (continuous), and pressure-sensing gasoline injection systems.
Compare the various types of gasoline injection systems.
Correctly answer ASE certification test questions on gasoline injection systems..
Explain OBD II testing features used on late-model fuel injection systems.
Cite safety rules for injection system service.
Correctly answer ASE certification test questions about fuel injection system diagnosis, service, and repair.

Explain the operating principles of an automotive ignition system.
Compare contact point, electronic, and computer-controlled ignition systems.
Describe the function of major ignition system components.
Explain vacuum, centrifugal, and electronic ignition timing advance.
Sketch the primary and secondary sections of an ignition system.
Compare ignition coil, spark plug, and distributor design variations.
Describe the safety practices that must be followed when working with ignition systems.
Correctly answer ASE certification test questions that require a knowledge of ignition system fundamentals.
List the symptoms produced by faulty ignition system components.
Describe common tests used to find ignition system troubles.
Explain how to replace or repair ignition system parts.
Summarize contact point and pickup coil adjustments.

Define the fundamental terms relating to automotive emission control systems.

Explain the sources of air pollution.
Describe the operating principles of emission control systems.
Compare design differences in emission control systems.
Explain how a computer or engine control module can be used to operate emission control systems.
Summarize how OBD II systems use multiple oxygen sensors to check air-fuel mixture and catalytic converter efficiency.
Correctly answer ASE certification test questions that require a knowledge of emission control system operation and construction.

Describe the basic parts of an exhaust system.
Compare exhaust system design differences.
Explain the fundamental parts of a turbocharging system.
Describe the construction and operation of a turbocharger and waste gate.
Summarize the construction and operation of a supercharging system.
Demonstrate an understanding of safety procedures for working on exhaust systems, turbochargers, and superchargers.
Correctly answer ASE certification test questions on exhaust system, turbocharger, and supercharger operation and service.

List the most common engine performance ¬problems.
Describe the symptoms for common engine performance problems.
Explain typical causes of engine performance problems.
Use a systematic approach when diagnosing engine performance problems.
Correctly answer ASE certification test questions on problems affecting engine performance.
Explain the principles of an oscilloscope.
Summarize how to use waveforms to analyze the operation of sensors, actuators, ECU outputs, and other electrical-electronic devices.
Evaluate ignition system waveforms.
Summarize how to use an engine analyzer.

Describe the typical difference between a minor tune-up.
List the basic steps for an engine tune-up.
Explain service operations commonly performed during a tune-up.
List the safety precautions that should be remembered during a tune-up.
Correctly answer ASE certification test questions on engine tune-up and engine problem diagnosis.

Skills:
Check a car's fluid levels.
Locate fluid leaks.
Replace engine oil and filter.
Change automatic transmission fluid and filter.
Perform a grease job.
Inspect for general problems with hoses, belts, and other components.
Demonstrate safe practices while working with vehicle fluids.
Perform a combustion leak test and a system pressure test.
Check the major parts of a cooling system for proper operation.
Replace faulty cooling system components.
Drain, flush, and refill a cooling system.

Locate the data link connector on most makes and models of cars.
Activate on-board diagnostics and read trouble codes with and without a scan tool.
Use a trouble code chart in a service manual or code conversion by a scan tool.
Erase diagnostic trouble codes.
Perform a visual inspection of the engine, its sensors, actuators, and the systems they monitor and control.
Test sensors and their circuits.
Remove and replace sensors.

Test and replace actuators.
Remove and replace a computer.
Remove and replace a computer PROM.
Program an EEPROM.
Demonstrate safe working practices when servicing automotive computers.

Repair a fuel line or replace a fuel hose.
Locate and replace fuel filters in both gasoline and diesel fuel systems.
Diagnose typical gasoline injection system problems.
Test a fuel pressure regulator.
Test both electronic and continuous fuel injectors.
Use a service manual when making basic adjustments on gasoline injection systems.

Diagnose typical ignition system problems.
Adjust ignition timing.

Inspect and troubleshoot emission control systems.
Perform periodic service operations on emission control systems.
Test individual emission control components.
Replace or repair major emission control components.
Demonstrate and practice safe work procedures.

Perform exhaust system repairs.
Remove and replace a turbocharger and waste gate.

Use advanced diagnostic techniques to troubleshoot difficult problems.
Use scan tool snapshot and datastream values to find problems not tripping trouble codes.
Use a breakout box to measure circuit values.

I. ENGINE REPAIR
A. General Engine Diagnosis; Removal and Reinstallation (R & R)
Task Number and Description Priority Page #s
11. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
P-1 94–95
12. Identify and interpret engine concern; determine necessary action.
P-1 137, 138–139, 871–896, 913–926
13. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins.
P-1 85–95
14. Locate and interpret vehicle and major component identification numbers.
P-1 86, 87, 269, 1072, 1110
15. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.
P-1 746, 786–788, 915
16. Diagnose engine noises and vibrations; determine necessary action.
P-2 138, 139, 916
17. Diagnose the cause of excessive oil consumption, coolant consumption, unusual engine exhaust color and odor; determine necessary action.
P-2 872–874, 892
18. Perform engine vacuum tests; determine necessary action.
P-1 872–874, 892
19. Perform cylinder power balance tests; determine necessary action.
P-2 895
10. Perform cylinder cranking and running compression tests; determine necessary action.
P-1 916–920
11. Perform cylinder leakage tests; determine necessary action.

P-1 920
12. Remove and reinstall engine in an OBDII or newer vehicle; reconnect all attaching components and restore the vehicle to running condition.
P-2 931–937, 1011, 1012
13. Install engine covers using gaskets, seals, and sealers as required.
P-1 119–124, 996–997, 1006–1007
14. Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads, and repair internal threads with thread insert.
P-1 117–120
15. Inspect, remove, and replace engine mounts.
P-2 925–926, 932–935
B. Cylinder Head and Valve Train Diagnosis and Repair
11. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specifications and procedures.
P-1 115–117, 942, 943, 990, 991
12. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition.
P-1 938, 939, 971–974
13. Inspect valve springs for squareness and free height comparison; determine necessary action.
P-3 983, 984
14. Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine necessary action.
P-3 984–986
15. Inspect valve guides for wear; check valve stem-to-guide clearance; determine necessary action.
P-3 974–976
16. Inspect valves and valve seats; determine necessary action.
P-3 974–983, 986
17. Check valve spring assembled height and valve stem height; determine necessary action.
P-3 984
18. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action.
P-2 989
19. Inspect valve lifters; determine necessary action.
P-2 988, 989
10. Adjust valves (mechanical or hydraulic lifters).
P-1 993–996
11. Inspect and replace camshaft and drive belt/chain (includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and variable valve timing components).
P-1 983–986, 989–993
12. Inspect and/or measure camshaft for runout, journal wear, and lobe wear.
P-2 987, 988
13. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine necessary action.
P-2 988
C. Engine Block Assembly Diagnosis and Repair
11. Disassemble engine block; clean and prepare components for inspection and reassembly.
P-1 940–945
12. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action.
P-2 948–955, 973
13. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine necessary action.
P-2 950, 951, 953, 954

14. Deglaze and clean cylinder walls.
P-2 951–953
15. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action.
P-3 988
16. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and journal wear; check crankshaft position sensor reluctor ring (where applicable); determine necessary action.
P-1 960–961, 963–964
17. Inspect main and connecting rod bearings for damage and wear; determine necessary action.
P-2 958, 961–963, 965
18. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine necessary action.
P-3 949, 954, 955
19. Inspect and measure piston skirts and ring lands; determine necessary action.
P-2 941, 954–958, 964, 965
10. Remove and replace piston pin.
P-3 956, 957, 958
11. Determine piston-to-bore clearance.
P-2 955–956
12. Inspect, measure, and install piston rings.
P-2 941, 955–956, 958–960
13. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance or silencer); inspect shaft(s) and support bearings for damage and wear; determine necessary action; reinstall and time.
P-2 936, 954, 955, 987, 988
14. Remove, inspect, or replace crankshaft vibration damper (harmonic balancer).
P-2 217
15. Assemble engine block.
P-1 120–124, 791–793, 962, 990–993, 996, 997, 1004–1007
D. Lubrication and Cooling Systems Diagnosis and Repair
11. Perform oil pressure tests; determine necessary action.
P-1 789
12. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action.
P-2 793–797
13. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; determine necessary action.
P-1 747–749
14. Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.
P-1 548–550, 756–757
15. Inspect and replace engine cooling and heater system hoses.
P-1 754, 755
16. Inspect, test, and replace thermostat and gasket/seal.
P-1 751–754
17. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.
P-1 132, 751, 754, 759–765
18. Inspect, remove and replace water pump.
P-2 750, 751
19. Remove and replace radiator.
P-2 756
10. Inspect, and test fans(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.
P-1 757, 758

11. Inspect auxiliary coolers; determine necessary action.
P-3 779
12. Inspect, test, and replace oil temperature and pressure switches and sensors.
P-2 798, 799
13. Perform oil and filter change.
P-1 128–130
14. Identify causes of engine overheating.

VIII. ENGINE PERFORMANCE
A. General Engine Diagnosis
1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
P-1 94–95
2. Identify and interpret engine performance concern; determine necessary action.
P-1 137–139, 859–866, 871–896, 913–926
3. Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins.
P-1 85–95, 862
4. Locate and interpret vehicle and major component identification numbers.
P-1 86, 87, 269, 1072, 1110
5. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.
P-2 914–916
6. Diagnose abnormal engine noise or vibration concerns; determine necessary action.
P-3 138, 139, 859, 916
7. Diagnose abnormal exhaust color, odor, and sound; determine necessary action.
P-2 431, 915, 916
NATEF Task List Correlation Chart 53
Task Number and Description Priority Page #s
8. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.
P-1 872–874
9. Perform cylinder power balance test; determine necessary action. P-2 895
10. Perform cylinder cranking and running compression tests; determine necessary action.
P-1 906, 916–920
11. Perform cylinder leakage test; determine necessary action.
P-1 920
12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action.
P-1 107, 108, 282–294, 599, 880–896
13. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action.
P-3 833–836, 837–840
14. Verify engine operating temperature; determine necessary action.
P-1 752
15. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.
P-1 746–749, 755, 756, 759–761
16. Verify correct camshaft timing.
P-1 1001–1004, 1009
B. Computerized Engine Controls Diagnosis and Repair
1. Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable.
P-1 268–277
2. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data.
P-1 268–277, 373, 374, 384–391, 622, 846–849

3. Diagnose emissions or driveability concerns without stored diagnostic trouble codes; determine necessary action.
P-1 283–294, 373, 374, 384–391, 622, 846–849
4. Check for module communication (including CAN/BUS systems)errors using a scan tool.
P-2 284
5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO); perform ecessary action.
P-1 282–294, 384–388, 622
6. Access and use service information to perform step-by-step diagnosis.
P-1 85–95, 269, 277
7. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems); determine necessary action.
P-3 683–687, 1110–1113, 1493,1544, 1545
8. Perform active tests of actuators using a scan tool; determine necessary action.
P-1 273, 875
C. Ignition System Diagnosis and Repair
1. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action.
P-1 595, 596, 621, 831, 863–866, 905
2. Inspect and test ignition primary and secondary circuit wiring and solid-state components; test ignition coil(s); perform necessary action.
P-1 600–602, 618–619
3. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action.
P-1 618
4. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary.
P-2 291–294
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action.
P-1 371–392, 403–408, 430–433, 863–867
2. Check fuel for contaminants and quality; determine necessary action.
P-2 308–309
3. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action.
P-1 329–334
4. Replace fuel filters.
P-2 135, 329, 330
5. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.
P-2 135, 334,377, 378, 391, 991–993
6. Inspect and test fuel injectors. P-1 376–381
7. Verify idle control operation. P-1 381–383, 407–408, 432–437
8. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.
P-1 450–455
9. Perform exhaust system backpressure test; determine necessary action.
P-1 449, 847
10. Test the operation of turbocharger/supercharger systems; determine necessary action.
P-3 450–458
E. Emissions Control Systems Diagnosis and Repair
1. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary

action.
P-2 798, 799, 804–809, 831–853
2. Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.
P-2 806–810, 842, 843
3. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action.
P-1 811–815, 845, 846
4. Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters and hoses; perform necessary action.
P-1 811–815, 845, 846
5. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.
P-2 811–815, 845, 846
6. Diagnose emissions and driveability concerns caused by the secondary air injection and catalytic converter systems; determine necessary action.
P-2 815–821, 846–849
7. Inspect and test mechanical components of secondary air injection systems; perform necessary action.
P-3 846, 847
8. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.
P-3 846, 847
9. Inspect and test catalytic converter efficiency.
P-1 847, 848
10. Diagnose emissions and driveability concerns caused by the evaporative emissions control system; determine necessary action.
P-1 808–811, 826, 843, 844
11. Inspect and test components and hoses of the evaporative emissions control system; perform necessary action.
P-1 843, 844
12. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action.
P-1 831, 832
F. Engine Related Service
1. Adjust valves on engines with mechanical or hydraulic lifters.
P-1 993–996
2. Remove and replace timing belt; verify correct camshaft timing.
P-1 1009–1011
3. Remove and replace thermostat and gasket/seal.
P-1 751–753
4. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.
P-1 757–758
5. Perform common fastener and thread repairs, to include: remove broken bolt, restore internal and external threads, and repair internal threads with a threaded insert.
P-1 117–120
6. Perform engine oil and filter change.
P-1 129–130
7. Identify hybrid vehicle internal combustion engine service precautions.

Remediation:
Re-teach major concepts
Review with teacher assistance
Study group
Worksheets
Individual tutoring
Group tutoring
Peer tutoring

Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

Enrichment:
Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.
Working on skills for SkillsUSA , Lehigh Valley Dealers Association, and/or Northampton Community College competitions

Special Adaptations:

Adaptations
Extended Time (assignments and/or testing)
Preferential Seating
Directions/Comprehension Check (frequent checks for understanding)
Study Guide
Directions and/or Tests Read Aloud
Adapted Tests and/or Assignments
Use of Calculator
Taking Tests in Alternate Setting (or if requested)
Verbal/Gestural Redirection (prompts to remain on task)
Drill and Practice (Repetition of Material)
Small Group Instruction
Provide Visual Model to Accompany Verbal Directions (Written/Oral Directions)
Use of Computer (Access to)
Positive Reinforcement
Have Student Repeat Directions
Wait Time
Access to School Counselor
Use of Highlighter/Highlighted Text
Provide Frequent Feedback
Provide Frequent Breaks
Regular Notebook Check
Variety of Assessment Methods
Highly Structured Classroom
Syllabus for Major Projects
Limited, Short Directions
Grading Rubric
Communication Regarding Behavior & Consequences (PBS)
Clear Language for Directions
Provide Opportunities to Retest
Frequent Review Sessions
Use a variety of Modalities when Introducing Skills/Concepts
Allow Oral Answers for Testing
Cue for Oral Response
De-Escalation Opportunities
Daily Classwork Check
Encourage Student to Check Work Before Turning In
Opportunities for Repeated Practice of MATH Skills
Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage

Provide Verbal and Written Directions
All Vocabulary to be Defined Before Testing
Time out
Encouragement to Participate in Positive Leadership Roles
Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

Safety:

Student Must:
Handle material in a safe manner.
Use protective clothing and equipment.
Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
Use proper safety precautions when using /operating hand tools.
Use tools and equipment in a professional work like manner according to OSHA standards.
Know and follow the established safety rules at all times.

Assessment:

Written test
Activity worksheets
Workbooks
Quizzes
Pre/Post Tests
Essays
Summaries
Time Cards
Writing Activities
Video/DVD Worksheets
Rubrics
Check Lists
Debates
Oral Presentation
Diagrams
Individual Projects
Group Projects
Research Papers
Current Events

Resources/Equipment:

Duffy, J.E.(2009).Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Module 2 Lessons 1-15 Automotive Engines and Module 4 Lessons 1-14 Engine Performance and Computer Fundamentals Modern Technology Service Technician (MAST) On-Line Training. (2008)).Tinley Park: IL: The Goodhearth-Willcox Company, Inc.

Duffy, J.E.(2009). Textbook,Workbook and Student Job Manual - Modern Automotive Technology (7th ed). Tinley Park: IL: The Goodheart-Willcox Company, Inc.

Snap-on Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions

Web base training software: Shopkey 5 Service Information
Automotive Technology Workbooks

MSDS hand book
NATEF Task Assessment Worksheet
Computers
Textbook:
Web base training - Service Information (ShopKey 5)
Common hand tools:
Wrenches--open end, box end, and combination
Sockets--shallow, deep, 6-point, 12-point, standard, and impact
Drive size--1/4 inch, 3/8 inch, 1/2 inch, and 3/4 inch
Socket accessories--speed handle, extensions 3 to 36 inches long, universals, flex handle, and T bar
Screwdrivers--flat blade (standard), Phillips, clutch, and Torx
Pliers--slip joint, water pump, diagonal cutting, vise grip, snap ring, needle nose, battery, and duck bill
Punches--taper, pin, and center
Hammers--ball peen, soft face, and brass
Coolant Pressure Test Kit
Electronic Stethoscope
Fuel Pressure Line Disconnect Kit
Micrometer Measuring Tool
Caliber Measuring Tool
Dial Indicator Measuring Tool
Above the ground vehicle lifts
Drive-On lifts with hydraulic jacks
Tripod Jack Stands
Screw Jack Stand
Standard Jack Stand
Four 2 ½ ton Floor Jacks
Torque Wrenches: 3/8 – ½ inch Drive
Inch Pound Torque wrench
Two Electric Reversible Drills
½ Inch Drive Impact Wrench – battery operated
½ Inch Drive Impact Air Wrench
3/8 Drive Air Impact Ratchet
¼ Air Impact Ratchet
Oil Caddy
Drain pans and funnels
School –Owned Shop Vehicles – 2002 Chevy S-10 Pick-up Truck, 1999 Chevy Cavaliers (2), 1995 Pontiac Bonneville, 1991 Honda Civic, 1991 Chevy Lumina, 1997 Jeep Cherokee, 2001 Chevy Astro Van, 1991 Ford Ranger Pick-up Truck, 1991 Buick Regal, 1991 Chevy Corsica, 1998 Subaru Legacy, 1998 Mitsubishi Mirage

Hyperlinks:
www.g-wonlinetextbooks.com

www.sp2.org

www.library.alldatapro.com

Unit Name: 1200 HEATING AND AIR CONDITIONING

Number: 1200 **Hours:** 10.00

Dates: Spring 2016

Last Edited By: Automotive Technology (05-12-2016)

Description / Objectives:

Students will be able to identify, troubleshoot and demonstrate knowledge related to service information regarding heating and air conditioning maintenance.

Tasks:

1201 Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
1202 Inspect and replace A/C compressor drive belts, pulleys, and tensioners; determine necessary action.
1203 Inspect A/C condenser for airflow restrictions; determine necessary action.
1204 Inspect engine cooling and heater systems hoses; perform necessary action.
1205 Inspect A/C-heater ducts, doors, hoses, cabin filters, and outlets; perform necessary action.

Standards / Assessment Anchors

Focus Anchor/Standard #1:

- Pennsylvania Core Standards for Reading for Technical Subjects Standard 3.5

Supporting Anchor/Standards:

KEY IDEAS/DETAILS GRADES 9-10-11-12
Standard CC.3.5.9-10.A / Standard CC.3.5.11-12A Cite specific textual evidence, etc.
Standard CC.3.5.9-10 B / Standard CC.3.5.11-12 B Determine the central ideas or conclusions of a text; etc.
Standard CC.3.5.9-10.C / Standard CC.3.5.11-12.C Follow precisely a complex multistep procedure, etc.
CRAFT & STRUCTURE GRADES 9-10-11-12
Standard CC.3.5.9-10. D / Standard CC.3.5.11-12.D Determine the meaning of symbols, key terms, and other domain specific words.
Standard CC.3.5.9-10.E / Standard CC.3.5.11-12.E Analyze the structure of the relationships among concepts in a text, etc.
Standard CC.3.5.9-10.F / Standard CC.3.5.11-12.F Analyze the author's purpose in providing an explanation, describing a procedure...and Analyze the structure of the relationships among concepts in a text.
INTEGRATE KNOWLEDGE & IDEAS GRADES 9-10
Standard CC.3.5.9-10.G Translate quantitative or technical information expressed in a text into visual form (e.g. a table or chart).
Standard CC.3.5.9-10. H Assess the reasoning in a text to support the author's claim for solving a technical problem.
Standard CC.3.5.9-10. I Compare and contrast findings presented in a text to those from other sources, etc.
INTEGRATE KNOWLEDGE & IDEAS GRADES 11-12

Standard CC.3.5.11-12. G Integrate and evaluate multiple sources of information presented in diverse formats...to solve a problem.
Standard CC.3.5.11-12. H Evaluate the hypotheses, data, analysis, and conclusions in a technical text, verifying the data when possible.
Standard CC.3.5.11-12. I Synthesize information from a range of sources into a coherent understanding.
RANGE OF READING GRADES 9-10-11-12
Standard CC.3.5.9-10.J / Standard CC.3.5.11-12.J By the end of grades 9-10, AND 11- 12, read and comprehend technical texts independently and proficiently.

Focus Anchor/Standard #2:

- Pennsylvania Core Standards for Writing for Technical Subjects Standard 3.6

Supporting Anchor/Standards:

TEXT TYPES AND PURPOSE GRADES 9-10-11-12
Standard CC.3.6.9-10.A Standard CC.3.6.11-12.A Write arguments focused on discipline specific content.
Standard CC.3.6.9-10.B Standard CC.3.6.11-12.B Write informative or explanatory texts, including the narration of technical processes, etc.
PRODUCTION & DISTRIBUTION OF WRITING GRADES 9-10-11-12
Standard CC.3.6.9-10.C Standard CC.3.6.11-12 C Produce clear and coherent writing...appropriate to task, purpose, and audience.
Standard CC.3.6.9-10 D Standard CC.3.6.11-12.D Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
Standard CC.3.6.9-10.E Standard CC.3.6.11-12.E. Use technology, including the internet, to produce, publish, and update individual or shared writing products.
RESEARCH GRADES 9-10-11-12
Standard CC.3.6.9-10.F Standard CC.3.6.11-12.F Conduct short and more sustained research to answer a question or solve a problem.
Standard CC.3.6.9-10.G. Standard CC.3.6.11-12.G Gather relevant information from multiple authoritative print and digital sources, following a standard format for citation.
Standard CC.3.6.9-10.H. Standard CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.
RANGE OF WRITING GRADES 9-10-11-12
Standard CC.3.5.9-10.I & Standard CC.3.5.11-12.I. Write routinely over extended time frames and shorter time frames for a range of tasks, purposes and audiences...etc.

Connecting Anchor/Standard:

- Pennsylvania Core Standards for Mathematics Standard 2.0

Supporting Anchor/Standards:

NUMBERS AND OPERATIONS
Standard 2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.
Standard 2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multistep problems.
Standard 2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Standard 2.1.HS.F.6 Extend the knowledge of arithmetic operations and apply to complex numbers

ALGEBRA
Standard 2.2.HS.C.9 Prove the Pythagorean identity and use it to calculate trigonometric ratios.
GEOMETRY
Standard 2.3.HS.A.7 Apply trigonometric ratios to solve problems involving right triangles.
Standard 2.3.HS.A.3 Verify and apply geometric theorems as they relate to geometric figures.
Standard 2.3.HS.A.13 Analyze relationships between two dimensional and three dimensional objects.

Instructional Activities:

Knowledge:

Participate in lecture and discussion and respond to questions.
Complete reading assignments.
Complete written assignments.
Participate with the group activities.
Complete Task Sheet Assignment.
List all the parts of the cylinder head, engine oiling system, and cooling system.
Analyze the purposes of valve guides, seals, seats, springs, keepers, retainers, rotators.
Identify the parts in the valve operating mechanism including lifters, pushrods, rocker-arms, camshaft, oil gauges.
Explain the importance of vehicle maintenance.
Correctly answer ASE certification test questions on fluid service and vehicle maintenance.

Summarize the functions of a cooling system.
Explain the operation and construction of major cooling system components.
Compare cooling system design variations.
Explain the importance of antifreeze.
Discuss safety procedures to follow when working with cooling systems.
Correctly answer ASE certification test questions on cooling system construction and operation.

List common cooling system problems and their symptoms.
Describe the most common causes of system leakage, overheating, and overcooling.
Describe safe working practices to use when testing, maintaining, or repairing a cooling system.
Correctly answer ASE certification test questions on cooling system troubleshooting and repair.

Skills:

Check a car's fluid levels.
Locate fluid leaks.
Replace engine oil and filter.
Change automatic transmission fluid and filter.
Perform a grease job.
Inspect for general problems with hoses, belts, and other components.
Demonstrate safe practices while working with vehicle fluids.
Perform a combustion leak test and a system pressure test.
Check the major parts of a cooling system for proper operation.
Replace faulty cooling system components.
Drain, flush, and refill a cooling system.

Remediation:
Re-teach major concepts
Review with teacher assistance
Study group

Worksheets
Individual tutoring
Group tutoring
Peer tutoring
Study groups
Review games
Reading comprehension packets
Placing events in a time line
Create a chart
Retest or alternative assessment
Technology integration
Study guides
Computer assisted instruction
Checklists

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Student will work on NATEF required tasks from student workbook to earn one year of industry credit toward ASE Certification.
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Use of Computer (Access to)
Positive Reinforcement
Have Student Repeat Directions
Wait Time
Access to School Counselor
Use of Highlighter/Highlighted Text
Provide Frequent Feedback
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Provide repetition During Initial Instruction
Allow Pre-read of Questions Before Reading Written Passage
Provide Verbal and Written Directions
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Student Self-Evaluation for Behavior
Exempt from reading Aloud in Front of Peers

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Student Must:
Handle material in a safe manner.
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Use hand tools in a safe manner.
Use adequate ventilation when working in enclosed area.
Follow manufacturer's directions when using any product, tool, equipment, etc.
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Use tools and equipment in a professional work like manner according to OSHA standards.
Know and follow the established safety rules at all times.

Assessment:

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Essays
Summaries
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Snap-on Incorporated. (2008). ShopKey (Version 5.8.1). Kenosha, WI: Mitchell1 Shop Management Solutions

Web base training software: ShopKey 5 Service Information
Automotive Technology Workbooks
MSDS hand book
NATEF Task Assessment Worksheet
Computers
Textbook:
Web base training - Service Information (ShopKey 5)
Common hand tools:
Wrenches--open end, box end, and combination
Sockets--shallow, deep, 6-point, 12-point, standard, and impact
Drive size--1/4 inch, 3/8 inch, 1/2 inch, and 3/4 inch
Socket accessories--speed handle, extensions 3 to 36 inches long, universals, flex handle, and T bar
Screwdrivers--flat blade (standard), Phillips, clutch, and Torx
Pliers--slip joint, water pump, diagonal cutting, vise grip, snap ring, needle nose, battery, and duck bill
Punches--taper, pin, and center
Hammers--ball peen, soft face, and brass
Coolant Pressure Test Kit
Electronic Stethoscope
Fuel Pressure Line Disconnect Kit
Micrometer Measuring Tool
Caliber Measuring Tool
Dial Indicator Measuring Tool
Above the ground vehicle lifts
Drive-On lifts with hydraulic jacks
Tripod Jack Stands
Screw Jack Stand
Standard Jack Stand
Four 2 ½ ton Floor Jacks
Torque Wrenches: 3/8 – ½ inch Drive
Inch Pound Torque wrench
Two Electric Reversible Drills
½ Inch Drive Impact Wrench – battery operated
½ Inch Drive Impact Air Wrench
3/8 Drive Air Impact Ratchet
¼ Air Impact Ratchet
Oil Caddy
Drain pans and funnels
School –Owned Shop Vehicles – 2002 Chevy S-10 Pick-up Truck, 1999 Chevy Cavaliers (2), 1995 Pontiac Bonneville, 1991 Honda Civic, 1991 Chevy Lumina, 1997 Jeep Cherokee, 2001 Chevy Astro Van, 1991 Ford Ranger Pick-up Truck, 1991 Buick Regal, 1991 Chevy Corsica, 1998 Subaru Legacy, 1998 Mitsubishi Mirage

Hyperlinks:
www.g-wonlinetextbooks.com

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www.library.alldatapro.com