

# *Course of Study*

## *Automotive Technology Tech Prep*

**Warren County Career Center**

**3525 North State Route 48  
Lebanon, Ohio 45036**

**Adopted 06-28-07**

*This document is for the use of the staff at Warren County Career Center.  
Credit is given the designer of the template, Upper Valley JVS, Piqua, Ohio.*

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# *Acknowledgements*

## **Automotive Technology Tech Prep Warren County Career Center**

We would like to take this opportunity to express our gratitude to the following people for their guidance and support in the preparation of this course of study:

Warren County Career Center Administrative Team  
Warren County Educational Service Center  
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***Warren County Career Center  
Resolution Of School Board Approval***

WHEREAS, representatives of Career-Technical Advisory Committee of the Warren County Career Center have reviewed the Automotive Technology Tech Prep Course of Study; and

WHEREAS, this Course of Study is based upon Integrating Technical and Academic Competencies adopted by the State of Ohio for the Automotive Technology Tech Prep program; and

WHEREAS, the Automotive Technology faculty and the Career-Technical Advisory Committee have reviewed and added competencies as needed to address local labor market needs and trends in the industry;

NOW, THEREFORE, BE IT RESOLVED, in accordance with the Superintendent's recommendation, that the Warren County Career Center adopt the Automotive Technology Tech Prep Course of Study.

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District Superintendent

Date

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President, Board of Education

Date

## *Statement of Recommendation*

The Automotive Technology Advisory Committee at Warren County Career Center has reviewed this course of study and recommends it for use as the foundation for instruction in the Automotive Technology Tech Prep class.

The developers of this course of study have considered local labor market needs and the school's ability to offer specialized programs. The competencies have been reviewed and accepted as being congruent with our school's vision, mission, and strategic goals. When appropriate, additional competencies related to the program area have been incorporated into this course of study.

Achievement of technical competencies, utilizing proper attitudes, and demonstrating appropriate values are critical for successful employment and for furthering educational opportunities within a student's chosen field. We believe that this course of study adequately and correctly focuses upon student development.

This course of study is recommended on: 06-28-07

## ***Warren County Career Center Vision Statement***

WCCC is the valued partner of choice within the educational and economic systems of our communities, by providing quality academic and career technical education.

We pave the way for a future of opportunities unique to each of our learners.

## ***Warren County Career Center Mission Statement***

To prepare youths and adults to make informed career choices and to successfully enter, compete, and advance in a changing work world.

## ***Warren County Career Values***

- Treating each other with respect, dignity, trust and mutual value
- Communicating openly and honestly
- Taking ownership of personal actions and being held accountable for results
- Upholding and demonstrating high ethical, educational and fiscal standards
- Exhibiting high levels of professionalism
- Providing high quality instruction and highly qualified staff to ensure success for all learners
- Making quality customer service a high priority
- Promoting partnerships and a team environment
- Celebrating team and individual achievements
- Using data to drive planning, decision making and actions

## *Course Design*

Courses are designed to reflect career-focused education, which combines high-level academics with real-life technical skills. The intent is to maximize a student's present and future academic and career success.

Career-focused education enhances the integration of academic and technical skills, designs programs that prepare students with transferable skills and promotes each student's career opportunities.

## *Course Philosophy*

We believe that the primary goal of the Automotive Technology Tech Prep Program is to develop adults who will successfully work in the automotive industry in which they are trained as contributing members. Graduates possess skills, which enhance their ability to secure and keep desirable employment.

We believe that the Automotive Technology Tech Prep Program will provide students with self-confidence to utilize life long learning skills to solve problems, think critically, and make decisions affecting their personal and professional lives.

We believe the Automotive Technology Tech Prep Program should enable students to gain knowledge and skills needed to enter the job market, participate in further educational programs and recognize the rights and responsibilities as productive citizens of our society.

## ***Course Goals***

The course goals for Automotive Technology Tech Prep Program are to:

1. Develop competencies in the following areas in order to prepare students for gainful employment in entry-level (or higher) jobs in their chosen specialties:

Engine Repair

Engine Performance

Suspension and Steering

Brakes

Automatic Transmission/ Transaxle

Manual Drive Train and Axles

Heating and Air Conditioning

Electrical Systems

Automotive Shop Management

2. Develop the student's competency in the academic areas of communications, mathematics, and science.
3. Provide opportunities for students to develop employability competencies needed in the automotive industry through participation in leadership, citizenship, and cooperative activities.

## ***Course Description***

In the Automotive Technology Tech Prep Program, students learn everything from brake repair to motor tune-ups, and other major repairs such as front-end alignment, engine testing, transmission repair, and engine overhaul.

Students also learn to troubleshoot computer controlled automotive systems. In addition, they learn cost estimation, rebuilding, and replacing of automotive parts.

This program has attained national certification from the National Automotive Technician Education Foundation, commonly known as Automotive Service Excellence, ASE.

## ***Academic and Technical Integration***

Expectations of curriculum must be aligned with what is written, taught, assessed, and reported. Student expectations focus on active, project-centered learning—an approach to learning that emphasizes a connection between ideas in a discipline and the outside world. Educational programming and course content will clearly connect career and post-secondary opportunities. At the Warren County Career Center, the main goal is to design courses and projects that use strategies for authentic instruction. These characteristics of instruction focus on deep understanding, established opportunities for concept connections, provide anticipatory and abstract thinking, and emphasize genuine application.

The academic courses at the WCCC follow the state model curricula. They are designed to meet both associate school and state requirements. These standards respond to the need to improve student achievement, quality of curriculum and instruction, and strengthen school and community relationships.

## ***Technology***

The Warren County Career Center board and staff believe that technology skills are essential for all students to achieve in the 21<sup>st</sup> century. It is the goal of this district to infuse technology into all facets of education:

- Instruction
- Assessment
- Administration
- Career planning
- Course design
- Professional development

Strategies to incorporate technology into all facets of education are a priority of the district and there is commitment to a continual process to provide updated hardware, software, and professional development for staff members for the purpose of providing a high quality education, with the integration of technology, for all students.

## ***Job Shadowing***

Job Shadowing is designed to give the student a short-term overview of the many opportunities within a career field. Career-technical instructors confer with students to determine appropriate experiences.

Internships and Job Placement vary somewhat, but during each experience students should accomplish the following goals:

1. Work with mentors, supervisors, co-workers, and others to accomplish assigned tasks that contribute to the long- and short-term goals of the student. All aspects of the internship/placement (including dates, times, responsibilities, evaluations, etc.) will be outlined in an approved Internship Learning Plan that is coordinated by the career-technical instructor.
2. Apply basic skills and knowledge to "real world" business settings and learn new skills that are relevant to the career path.
3. Demonstrate a solid understanding of the basic skills outlined in the Internship Learning Plan.
4. Reflect upon the internship/placement/job shadowing in terms of post-secondary education/career options.

The criterion for participation in career-based learning experiences is included in the approved packet for each activity and may be obtained by the instructor.

The specifics of how these opportunities are offered in this career-technical program or statement of academic support are:

Students that meet the requirements set forth by the Early Placement Committee are eligible to work with local businesses during the second semester of their senior year. This allows the student to work during designated lab time with the approval of the Instructor. The Instructor will monitor academic eligibility along with the status of their field progress using contractor evaluations. In addition, parent approval and a written contract with the student for certain goals to be achieved will be required.

*Students Served*

The population served by this program is juniors and seniors.

# *Scope and Sequence*

## **Transportation Systems**

### **Competency Chart**

At the end of the secondary program (12) and associate degree (AD) each competency is coded: I = Introductory; P = Proficient; R = Reinforce. In addition, the business, industry and labor (BIL) partnership validated each competency: BIL: E = Essential; R = Required

<b>Competency</b>	<b>12</b>	<b>AD</b>	<b>BIL</b>
<b>Transportation Systems Core Body of Knowledge</b>			
<b>Unit 1: Career Exploration and Development</b>			
1.1 Explore career pathways in transportation systems.	P	R	E
1.2 Explore professional development and career advancement opportunities for a transportation professional.	P	R	E
1.3 Demonstrate positive work behaviors and personal qualities.	P	R	E
1.4 Develop personal career goals and the objectives to meet those career goals.	P	R	E
<b>Unit 2: Business Foundations</b>			
2.1 Analyze the roles and major functions of transportation systems.	I	P	E
2.2 Develop a business process model for a transportation organization.	I	P	R
2.3 Explain the impact of economic, social and technological changes on a transportation organization.	I	P	E
2.4 Explain how planning and budgeting are used to accomplish organizational goals and objectives.	I	P	R
2.5 Explain material control and product inventories necessary to meet customer and business requirements.	I	P	R
2.6 Maintain compliance with organizational policies and government laws and regulations.	I	P	E
2.7 Explain how transportation businesses manage customer relationships.	I	P	E
2.8 Describe a management plan for business.	I	P	E
2.9 Identify basic procedures in the accounting cycle.	I	R	R
2.10 Define and explain the major measures transportation organization uses to manage and improve performance.	I	P	E
2.11 Explain the role of risk management in reducing risks and improving performance.	I	P	E
2.12 Explain entrepreneurship.	I	R	R
2.13 Explain the role of small business in the economy.	I	R	R
<b>Unit 3: Communications</b>			
3.1 Utilize reading strategies to interpret transportation systems data, information and analysis.	P	R	E
3.2 Locate, organize and reference written transportation systems information from various sources.	P	R	E
3.3 Write and utilize coherent and focused technical communications that support a defined perspective for transportation systems.	P	R	E

3.4 Deliver formal and informal presentations that demonstrate organization and delivery skill.	P	R	E
3.5 Listen and speak effectively to contribute to group discussions and meetings.	P	R	E
3.6 Apply active listening skills to obtain and clarify information provided in oral communications.	P	R	E
3.7 Utilize written documents to direct the transportation systems operations.	P	R	E
3.8 Research and respond to customer needs.	I	P	E
<b>Unit 4: Problem Solving and Critical Thinking</b>			
4.1 Employ critical thinking and problem solving skills independently and in teams to formulate solutions to problems.	P	R	E
4.2 Apply problem solving and critical thinking techniques to the conflict between available resources, requirements of the project and timelines.	I	P	E
4.3 Combine critical thinking and team-building skills to solve problems.	P	R	E
4.4 Evaluate and adjust plans and schedules to respond to unexpected events and conditions.	I	P	E
4.5 Apply mathematical principles and formulas to transportation systems problems.	I	P	E
4.6 Apply science theory and applications to transportation systems problems.	I	P	E
<b>Unit 5: Leadership and Teamwork</b>			
5.1 Summarize the interpersonal skills that contribute to positive leadership and teamwork.	P	R	E
5.2 Demonstrate the ability to work on a team and recognize the importance of teamwork and its impact on business in a transportation environment.	P	R	E
5.3 Perform responsibly as a team member.	P	R	E
5.4 Use motivational techniques to enhance performance in others.	I	P	E
5.5 Examine the different responses to conflict as they relate to results.	I	P	E
5.6 Resolve conflicts to maintain a smooth workflow.	I	P	E
<b>Unit 6: Legal and Ethical Aspects</b>			
6.1 Differentiate between legal and ethical issues.	I	P	E
6.2 Complete work-related duties within an ethical framework.	I	P	E
6.3 Assess the implications of ethical and unethical behavior.	I	P	E
6.4 Perform duties according to laws, regulations, contract provisions and policies.	I	P	E
6.5 Comply with applicable governmental regulations and codes.	I	P	E
6.6 Explain employee and employer liability (e.g., monetary and personal).	I	P	E
<b>Unit 7: Information Technology Applications</b>			
7.1 Use computer-based technology.	P	R	E
7.2 Employ information technology applications.	I	P	E
7.3 Use geographic information systems.	I	P	E
<b>Unit 8: Safety, Health and Environmental Aspects</b>			
8.1 Maintain general safety in accordance with government regulations, health standards, company policy, procedure and practices.	P	R	E
8.2 Evaluate the human and ergonomic factors associated with the transportation industry.	P	R	E
8.3 Identify state, federal and local worker safety, health and environmental regulations.	I	P	E
8.4 Demonstrate practices that contribute to a safe workplace environment.	I	P	E
8.5 Complete the requirements for first aid and CPR certification.	I	R	R

8.6 Complete and apply operations and safety training on pertinent equipment.	P	R	E
8.7 Identify practices that contribute to a healthy environment.	P	R	E
8.8 Handle hazardous materials in accordance with government regulations and health standards.	P	R	E
8.9 Analyze regulations for transporting hazardous materials.	I	P	E
<b>Unit 9: Transportation Fuels</b>			
9.1 Discuss the historical and economic impact of the petroleum industry.	I	P	R
9.2 Discuss the alternative vehicular fuel industry.	I	P	R
9.3 Compare and contrast viable fuels.	I	P	R
9.4 Discuss engine modifications related to the use of alternative fuels.	I	P	R
9.5 Discuss future vehicular fuel sources.	I	P	R
<b>Unit 10: Transportation Systems Technical Skills Sets</b>			
10.1 Explore the performance skills of an automotive technician.	I	P	E
10.2 Explore the performance skills of a medium and heavy transportation technician.	I	P	E
10.3 Explore the performance skills of a collision repair technician.	I	P	E
10.4 Explore the performance skills of an aviation maintenance technician.	I	P	E
10.5 Explore the performance skills of an aviation technology employee.	I	P	E
10.6 Explore the performance skills of a power equipment technician.	I	P	E
<b>GROUND TRANSPORTATION PATHWAY</b>			
<b>Automotive Technician</b>			
<b>Unit 11: Orientation to the Automotive Industry</b>			
11.1 Define the industry.	P	R	E
11.2 Determine the skills needed to work in the automotive industry.	P	R	E
<b>Unit 12: Tools and Equipment</b>			
12.1 Identify basic tools and equipment appropriate to the automotive industry.	P	R	E
12.2 Demonstrate appropriate use of basic hand tools to complete work functions.	P	R	E
12.3 Operate power tools and stationary equipment.	P	R	E
12.4 Maintain hand and power tools appropriate to the automotive industry.	P	R	E
12.5 Use appropriate personal protective equipment (PPE).	P	R	E
<b>Unit 13: Engine Repair</b>			
13.1 Perform general engine diagnosis, removal and reinstallation (R&R).	I	P	E
13.2 Perform cylinder head and valve train diagnosis and repair.	I	P	E
13.3 Perform engine block assembly diagnosis and repair.	I	P	E
13.4 Perform lubrication and cooling systems diagnosis and repair.	I	P	E
<b>Unit 14: Automatic Transmission and Transaxle</b>			
14.1 Perform general transmission and transaxle diagnosis.	I	P	E
14.2 Perform transmission and transaxle maintenance and adjustment.	I	P	E
14.3 Perform in-vehicle transmission and transaxle repair.	I	P	E
14.4 Perform off-vehicle transmission and transaxle repair.	I	P	E
14.5 Inspect, measure and reseal oil pump and converter.	I	P	E
14.6 Inspect and measure gear train, shafts, bushings and case.	I	P	E
14.7 Inspect and determine necessary action for friction and reaction units.	I	P	E
<b>Unit 15: Manual Drive Train and Axles</b>			
15.1 Perform general drive train diagnosis.	I	P	E
15.2 Perform clutch diagnosis and repair.	I	P	E

15.3 Perform transmission and/or transaxle diagnosis and repair.	I	P	E
15.4 Perform drive shaft and half shaft, universal and constant-velocity (CV) joint diagnosis and repair.	I	P	E
15.5 Evaluate ring and pinion gears and differential case assembly.	I	P	E
15.6 Diagnose limited slip differential.	I	P	E
15.7 Inspect drive axle shaft.	I	P	E
15.8 Perform four-wheel drive and all-wheel drive component diagnosis and repair.	I	P	E
<b>Unit 16: Suspension and Steering</b>			
16.1 Perform general suspension and steering systems diagnosis.	I	P	E
16.2 Perform steering systems diagnosis and repair.	I	P	E
16.3 Remove, inspect and install front suspension.	I	P	E
16.4 Remove, inspect and install rear suspension.	I	P	E
16.5 Perform miscellaneous service.	I	P	E
16.6 Perform wheel alignment diagnosis, adjustment and repair.	I	P	E
16.7 Perform wheel and tire diagnosis and repair.	I	P	E
<b>Unit 17: Brakes</b>			
17.1 Perform general brake systems diagnosis.	I	P	E
17.2 Perform hydraulic system diagnosis and repair.	I	P	E
17.3 Perform drum brake diagnosis and repair.	I	P	E
17.4 Perform disc brake diagnosis and repair.	I	P	E
17.5 Perform power assist unit diagnosis and repair.	I	P	E
17.6 Perform miscellaneous diagnosis and repair. including wheel bearings, parking brakes and electrical.	I	P	E
17.7 Diagnose antilock brake and traction control systems.	I	P	E
<b>Unit 18: Electrical and Electronic Systems</b>			
18.1 Perform general electric system diagnosis.	I	P	E
18.2 Remove and replace terminal end from connector.	I	P	E
18.3 Perform battery diagnosis and service.	I	P	E
18.4 Perform starting system diagnosis and repair.	I	P	E
18.5 Perform charging system diagnosis and repair.	I	P	E
18.6 Perform lighting systems diagnosis and repair.	I	P	E
18.7 Perform gauges, warning devices and driver information systems diagnosis and repair.	I	P	E
18.8 Perform horn and windshield wiper/washer diagnosis and repair.	I	P	E
18.9 Perform accessories diagnosis and repair.	I	P	E
<b>Unit 19: Heating and Air Conditioning (A/C)</b>			
19.1 Perform A/C system diagnosis and repair.	I	P	E
19.2 Perform refrigeration system component diagnosis and repair, including compressor and clutch.	I	P	E
19.3 Remove and inspect evaporator, condenser and related components.	I	P	E
19.4 Perform heating, ventilation and engine cooling systems diagnosis and repair.	I	P	E
19.5 Perform diagnosis and repair of operation systems and related controls.	I	P	E
19.6 Perform refrigerant recovery, recycling and handling.	I	P	E
<b>Unit 20: Engine Performance</b>			
20.1 Perform general engine diagnosis.	I	P	E
20.2 Perform diagnosis and repair of computerized engine controls.	I	P	E
20.3 Perform ignition system diagnosis and repair.	I	P	E

20.4 Perform fuel, air induction and exhaust systems diagnosis and repair.	I	P	E
<b>Unit 21: Emissions Control Systems Diagnosis and Repair</b>			
21.1 Diagnose positive crankcase ventilation system.	I	P	E
21.2 Evaluate exhaust gas recirculation system.	I	P	E
21.3 Evaluate exhaust gas treatment system.	I	P	E
21.4 Diagnose evaporative emissions controls system.	I	P	E
21.5 Perform engine-related service.	I	P	E

# Transportation Systems Core

## Unit 1: Career Exploration and Development

### BIL: Essential

EDU:	12	AD
	P	R

### Competency 1.1: Explore career pathways in transportation systems.

#### Descriptors:

- 1.1.1 Identify current and future career options for a person interested in transportation systems.
- 1.1.2 Research the historical evolution of the various careers in transportation systems.
- 1.1.3 Experience specific transportation interests (e.g., shadowing, professional readings, community service, internship).
- 1.1.4 Analyze the interrelationships between the transportation industry and other industries (e.g., business, agriculture, energy, travel and tourism).
- 1.1.5 Identify the education and licensing requirements needed for a career in transportation systems.

### Correlated English Language Arts Academic Content Benchmarks

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

*Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted.* (Research A, 8-10)

*Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted.* (Research A, 11-12)

*Evaluate the usefulness and credibility of data and sources.* (Research B, 8-10)

*Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

### Correlated Science Academic Content Benchmarks

*Recognize that scientific literacy is part of being a knowledgeable citizen.* (Scientific Ways of Knowing D, 9-10)

*Explain how societal issues and considerations affect the progress of science and technology.* (Scientific Ways of Knowing C, 11-12)

### BIL:Essential

EDU:	12	AD
	P	R

### Competency 1.2: Explore professional development and career advancement opportunities for a transportation professional.

#### Descriptors:

- 1.2.1 Identify advancement opportunities in transportation systems (e.g., internal and external).
- 1.2.2 Describe the importance of professional organizations, associations, seminars and

- 1.2.3 professional relationships with transportation professionals.
- 1.2.3 Remain current on changes in the transportation systems profession.
- 1.2.4 Demonstrate quality work as measured by performance evaluations.
- 1.2.5 Develop a résumé, list of references and a portfolio.

**Correlated English Language Arts Academic Content Benchmarks**

*Produce letters (e.g., business, letters to the editor, job applications) that follow the conventional style appropriate to the text, include appropriate details and exclude extraneous details and inconsistencies. (Writing Applications C, 8-10)*

*Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*  
*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources. (Research C, 11-12)*

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 1.3: Demonstrate positive work behaviors and personal qualities.**

**Descriptors:**

- 1.3.1 Conform to company and departmental policies (e.g., attendance, punctuality, time management).
- 1.3.2 Demonstrate professionalism, self-discipline, self worth, positive attitude and integrity in a work situation.
- 1.3.3 Demonstrate flexibility and willingness to learn.
- 1.3.4 Exhibit a commitment to the organization.
- 1.3.5 Explain how individuals impact performance in the transportation industry.
- 1.3.6 Describe the expectations for individuals in terms of performance.
- 1.3.7 Identify impact areas of individual performance (e.g., quality, profit, customer relations).
- 1.3.8 Discuss the importance of having all employees understand the core business processes of transportation organizations.
- 1.3.9 Demonstrate positive co-worker and employee/employer relationships.
- 1.3.10 Explain the importance of demonstrating appropriate workplace behaviors and the consequences and negative impacts (e.g. personal and company success) of workplace harassment.

**BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 1.4: Develop personal career goals and the objectives to meet those career goals.**

**Descriptors:**

- 1.4.1 Identify personal goals and objectives in concert with transportation organization goals.
- 1.4.2 Demonstrate the ability to seek and apply for employment.
- 1.4.3 Research employers and companies and the applicability of personal skill sets.
- 1.4.4 Prepare and interview for employment.
- 1.4.5 Demonstrate the ability to evaluate and compare employment opportunities.
- 1.4.6 Identify the motivations and personal rewards of effective career goals.

**Correlated English Language Arts Academic Content Benchmarks**

*Produce letters (e.g., business, letters to the editor, job applications) that follow the conventional style appropriate to the text, include appropriate details and exclude extraneous details and inconsistencies. (Writing Applications C, 8-10)*

*Evaluate the usefulness and credibility of data and sources. (Research B, 8-10)*

*Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*

*Use a variety of strategies to enhance listening comprehension. (Communications: Oral and Visual A, 8-10; Communications: Oral and Visual A, 11-12)*

*Select and use effective speaking strategies for a variety of audiences, situations and purposes. (Communications: Oral and Visual C, 11-12)*

**Unit 2: Business Foundations**

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 2.1: Analyze the roles and major functions of transportation systems.**

**Descriptors:**

- 2.1.1 Identify types of transportation organizations and their functions.
- 2.1.2 Describe and explain the mission of transportation organizations.
- 2.1.3 Use organizational charts to analyze workplace operations.
- 2.1.4 Describe and explain the major internal functions and structures of transportation organizations.
- 2.1.5 Define and explain the critical customers, suppliers, and stakeholders for transportation organizations.
- 2.1.6 Explain the major competitive challenges faced by organizations in the transportation industry.

**Correlated Mathematics Academic Content Benchmarks**

*Translate information from one representation (words, table, graph or equation) to another representation of a relation or function. (Patterns, Functions and Algebra C, 8-10)*

*Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability. (Data Analysis and Probability A, 8-10)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Mathematical Processes H, 8-10)*

**BIL:Recommended**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 2.2: Develop a business process model for a transportation organization.**

**Descriptors:**

- 2.2.1 Define business processes.

- 2.2.2 Identify and explain the core business operations in a transportation organization.
- 2.2.3 Prepare a diagram, chart and/or model that illustrates the organization.
- 2.2.4 Prepare a diagram, chart and/or model that illustrates the workflow through a transportation organization.
- 2.2.5 Demonstrate the fundamentals of systems thinking (e.g. integrate supply chain).

**Correlated English Language Arts Academic Content Benchmarks**

*Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)  
*Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 8-10; Research E, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Translate information from one representation (words, table, graph or equation) to another representation of a relation or function.* (Patterns, Functions and Algebra C, 8-10)  
*Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)  
*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)  
*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 2.3: Explain the impact of economic, social and technological changes on a transportation organization.**

**Descriptors:**

- 2.3.1 Explain the impact of economic changes, including economic income growth and decline, consumer confidence, interest rates, labor, and fuel and material costs.
- 2.3.2 Explain the impact of social changes, including consumer attitudes and preferences, demographics, and population shifts.
- 2.3.3 Explain quality assurance systems and how they contribute to effective work organizations.
- 2.3.4 Describe productivity issues related to transportation (e.g., employee productivity, quality).
- 2.3.5 Explain the impact of technological changes, including transportation and information technology.
- 2.3.6 Explain the major competitive challenges faced by transportation businesses.
- 2.3.7 Describe historical influences on transportation (e.g., labor movement, high-performance, quality).

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)  
*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Translate information from one representation (words, table, graph or equation) to another representation of a relation or function. (Patterns, Functions and Algebra C, 8-10)*

*Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability. (Data Analysis and Probability A, 8-10)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Mathematical Processes H, 8-10)*

**BIL:Recommended**

EDU:	12	AD
	I	P

**Competency 2.4: Explain how planning and budgeting are used to accomplish organizational goals and objectives.**

**Descriptors:**

- 2.4.1 Explain how work plans and budgets are used to allocate people and resources.
- 2.4.2 Identify reports used to track performance and resources, and explain how they are used.
- 2.4.3 Explain how plans and budgets are revised to meet goals and objectives.
- 2.4.4 Explain the impact of long term goals and planning on organization performance.
- 2.4.5 Identify and describe the most critical performance problems that transportation businesses typically face.
- 2.4.6 Describe how improvements are identified and modifications are implemented.

**Correlated English Language Arts Academic Content Benchmarks**

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)*

*Evaluate the usefulness and credibility of data and sources. (Research B, 8-10)*

**Correlated Mathematics Academic Content Benchmarks**

*Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Patterns, Functions and Algebra D, 8-10)*

*Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability. (Data Analysis and Probability A, 8-10)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Mathematical Processes H, 8-10)*

**BIL:Recommended**

EDU:	12	AD
	I	P

**Competency 2.5: Explain material control and product inventories necessary to meet customer and business requirements.**

**Descriptors:**

- 2.5.1 Analyze the relationship of quality control to supply of materials.
- 2.5.2 Identify inventory control systems and system reliability used in business (e.g., just-in-time) and its relationship to transportation costs and risks.
- 2.5.3 Analyze the impact of inventory control systems on productivity and profit or loss.

**Correlated English Language Arts Academic Content Benchmarks**

*Evaluate the usefulness and credibility of data and sources.* (Research B, 8-10)  
*Organize information from various resources and select appropriate sources to support central ideas, concepts and themes.* (Research C, 8-10)

**Correlated Mathematics Academic Content Benchmarks**

*Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis.* (Data Analysis and Probability E, 8-10)  
*Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)  
*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 2.6: Maintain compliance with organizational policies and government laws and regulations.**

**Descriptors:**

- 2.6.1 Identify and explain relevant organizational policies and regulations for general functions that are driven by government laws and regulations.
- 2.6.2 Identify and explain relevant government laws and regulations for specific functions within transportation organizations.
- 2.6.3 Examine the governmental roles in managing the infrastructure of transportation operations.
- 2.6.4 Explain the governmental roles in health, safety and environment management.

**Correlated English Language Arts Academic Content Benchmarks**

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)  
*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 2.7: Explain how transportation businesses manage customer relationships.**

**Descriptors:**

- 2.7.1 Conduct in-depth investigation to identify internal and external customer needs.
- 2.7.2 Maintain a liaison with customer contacts.
- 2.7.3 Maintain customer satisfaction and address customer problems and complaints efficiently.
- 2.7.4 Communicate with internal and/or external customers to ensure products or services meet customer requirements.

**Correlated English Language Arts Academic Content Benchmarks**

*Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted. (Research A, 11-12)*

*Use a variety of strategies to enhance listening comprehension. (Communications: Oral and Visual A, 8-10; Communication A, 11-12)*

*Select and use effective speaking strategies for a variety of audiences, situations and purposes. (Communications: Oral and Visual C, 11-12)*

**Correlated Mathematics Academic Content Benchmarks**

*Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis. (Data Analysis and Probability E, 8-10)*

*Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. (Data Analysis and Probability C, 11-12)*

*Connect statistical techniques to applications in workplace and consumer situations. (Data Analysis and Probability D, 11-12)*

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Mathematical Processes H, 8-10)*

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 11-12)*

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 2.8: Describe a management plan for business. Descriptors:**

- 2.8.1 Describe strategies to achieve company goals and objectives.
- 2.8.2 Design an organizational chart with job and activity descriptions.
- 2.8.3 Identify market segments and perspective clients.
- 2.8.4 Describe a business development plan.
- 2.8.5 Define and explain the role of research and development.

**Correlated English Language Arts Academic Content Benchmarks**

*Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*

**Correlated Mathematics Academic Content Benchmarks**

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data Analysis and Probability A, 11-12)*

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 11-12)*

**BIL:Recommended**

EDU:	12	AD
	I	R

**Competency 2.9: Identify basic procedures in the accounting cycle.**

**Descriptors:**

- 2.9.1 Describe the basic application of internal and external accounting.
- 2.9.2 Describe the essential nature of profitability and value.
- 2.9.3 Describe job costing with direct and indirect costs.
- 2.9.4 Explain basic economic concepts (e.g., supply, demand, price, cost, profit, value, cash flow).
- 2.9.5 Recognize accounting as part of the organizational team.

**Correlated Mathematics Academic Content Benchmarks**

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number, Number Sense and Operations G, 8-10)*

*Translate information from one representation (words, table, graph or equation) to another representation of a relation or function. (Patterns, Functions and Algebra C, 8-10)*

*Analyze and compare functions and their graphs using attributes, such as rates of change, intercepts and zeros. (Patterns, Functions and Algebra E, 8-10)*

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 11-12)*

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 2.10: Define and explain the major measures a transportation organization uses to manage and improve performance.**

**Descriptors:**

- 2.10.1 Define and explain the measures for financial performance (e.g. profitability, cost reduction, asset utilization).
- 2.10.2 Define and explain the measures for market performance (e.g., customer and sales and/or service growth).
- 2.10.3 Define and explain the operational measures for service and internal operations performance (e.g., customer satisfaction, service quality, cycle time, on-time delivery, claims-free handling).
- 2.10.4 Define and explain the measures for organizational compliance and health, safety and environmental performance (e.g., audit findings, emissions, lost time accidents).
- 2.10.5 Describe benchmark performances against competitors and the general industry.
- 2.10.6 Describe the continuous improvement process.

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Solve increasingly complex non-routine measurement problems and check for reasonableness of results.* (Measurement A, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 2.11: Explain the role of risk management in reducing risks and improving performance.**

**Descriptors:**

- 2.11.1 Explain the concept of risk management programs.
- 2.11.2 Describe the major types of loss exposures for a transportation organization, including property, liability, personnel and net income.
- 2.11.3 Describe the approaches for managing organizational risks.
- 2.11.4 Describe the employees’ role in risk management.

**Correlated Mathematics Academic Content Benchmarks**

*Connect statistical techniques to applications in workplace and consumer situations.* (Data Analysis and Probability D, 11-12)

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

**BIL:Recommended**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	R

**Competency 2.12: Examine entrepreneurship.**

**Descriptors:**

- 2.12.1 Compare personal interests and skills with those needed by an entrepreneur.
- 2.12.2 Examine the abilities and aptitudes needed to become a successful entrepreneur.
- 2.12.3 Determine motives for becoming an entrepreneur.
- 2.12.4 Examine characteristics of entrepreneurs.
- 2.12.5 Compare business ownership to working for others.

- 2.12.6 Explain the risks and rewards of business ownership.
- 2.12.7 Examine the relationship of small business to the state, national and global economies.
- 2.12.8 Explain how an entrepreneurial mindset can affect a company.

**Correlated English Language Arts Academic Content Benchmarks**

*Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*

**Correlated Mathematics Academic Content Benchmarks**

*Connect statistical techniques to applications in workplace and consumer situations. (Data Analysis and Probability D, 11-12)*

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Mathematical Processes H, 8-10)*

**BIL: Recommended**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>R</b>

**Competency 2.13: Explain the role of small business in the economy.**

**Descriptors:**

- 2.13.1 Explain the need for entrepreneurial discovery.
- 2.13.2 Determine opportunities for venture creation.
- 2.13.3 Assess opportunities for venture creation.
- 2.13.4 Describe idea-generation methods.
- 2.13.5 Generate venture ideas.
- 2.13.6 Determine the feasibility of ideas.

**Correlated English Language Arts Academic Content Benchmarks**

*Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted. (Research A, 8-10)*

*Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted. (Research A, 11-12)*

*Organize information from various resources and select appropriate sources to support central ideas, concepts and themes. (Research C, 8-10)*

**Correlated Mathematics Academic Content Benchmarks**

*Connect statistical techniques to applications in workplace and consumer situations. (Data Analysis and Probability D, 11-12)*

*Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)*

**Unit 3: Communications**

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 3.1: Utilize reading strategies to interpret transportation systems data, information and analysis.**

**Descriptors:**

- 3.1.1 Skim, read for detail, read for meaning and for critical analysis, to determine the purpose of a text.
- 3.1.2 Describe the content, technical concepts and vocabulary to analyze information and follow directions.
- 3.1.3 Interpret, transcribe and communicate information, data and observations to apply information learned from reading to actual practice.

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

*Apply reading comprehension strategies to understand grade-appropriate text.* (Reading Process A, 8-10; Reading Process A, 11-12)

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

*Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 3.2: Locate, organize and reference written transportation systems information from various sources.**

**Descriptors:**

- 3.2.1 Locate written information to communicate with co-workers, clients and participants.
- 3.2.2 Organize information to use in written and oral communications.
- 3.2.3 Document the source and proper reference for written information.

**Correlated English Language Arts Academic Content Benchmarks**

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

*Use style guides to produce oral and written reports that give proper credit for sources (e.g., words, ideas, images and information) and include an acceptable format for source acknowledgement.* (Research D, 8-10; Research D, 11-12)

*Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 8-10; Research E, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Translate information from one representation (words, table, graph or equation) to another representation of a relation or function.* (Patterns, Functions and Algebra C, 8-10)

*Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions*

*in a complete and easily understood manner. (Mathematical Processes H, 8-10)*

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 11-12)*

**BIL:Essential**

EDU:	12	AD
	P	R

**Competency 3.3: Write and utilize coherent and focused technical communications that support a defined perspective for transportation systems.**

**Descriptors:**

- 3.3.1 Use various note-taking techniques to summarize main ideas.
- 3.3.2 Structure ideas and arguments in an organized manner and that are supported by relevant documentation and/or examples.
- 3.3.3 Write messages using language that is appropriate for the intended audience and purpose.
- 3.3.4 Use correct spelling, grammar, capitalization and punctuation.
- 3.3.5 Identify positions from relevant research and resources.
- 3.3.6 Calculate and interpret descriptive statistics to communicate and support predictions and conclusions.
- 3.3.7 Utilize tables, charts and graphs to clarify textual explanations and support arguments.

**Correlated English Language Arts Academic Content Benchmarks**

*Formulate writing ideas, and identify a topic appropriate to the purpose and audience. (Writing Process A, 8-10; Writing Process A, 11-12)*

*Prepare writing for publication that is legible, follows an appropriate format and uses techniques such as electronic resources and graphics. (Writing Process F, 8-10)*

*Prepare writing for publication that follows an appropriate format and uses a variety of techniques to enhance the final product. (Writing Process F, 11-12)*

*Edit to improve sentence fluency, grammar and usage. (Writing Process D, 8-10)*

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

*Organize information from various resources and select appropriate sources to support central ideas, concepts and themes. (Research C, 8-10)*

**Correlated Mathematics Academic Content Benchmarks**

*Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability. (Data Analysis and Probability A, 8-10)*

*Evaluate different graphical representations of the same data to determine which is the most appropriate representation for an identified purpose. (Data Analysis and Probability B, 8-10)*

*Find, use and interpret measures of center and spread, such as mean and quartiles, and use those measures to compare and draw conclusions about sets of data. (Data Analysis and Probability D, 8-10)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data Analysis and Probability A, 11-12)*

*Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data Analysis and Probability B, 11-12)*

*Write clearly and coherently about mathematical thinking and ideas. (Mathematical Processes G, 8-10)*

### Correlated Science Academic Content Benchmarks

*Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations. (Scientific Inquiry A, 9-10)*

*Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data. (Scientific Inquiry A, 11-12)*

#### **BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

### **Competency 3.4: Deliver formal and informal presentations that demonstrate organization and delivery skill.**

#### **Descriptors:**

- 3.4.1 Demonstrate appropriate usage of grammar, diction and sentence structure.
- 3.4.2 Communicate main ideas and supporting facts to achieve the purpose of communication.
- 3.4.3 Use appropriate technology to enhance the clarity and persuasiveness.
- 3.4.4 Use proper organization and structure to achieve coherence.
- 3.4.5 Use technical terms, references and quoted material properly.
- 3.4.6 Engage an audience using appropriate vocal variety and gestures.

### Correlated English Language Arts Academic Content Benchmarks

*Demonstrate an understanding of effective speaking strategies by selecting appropriate language and adjusting presentation techniques. (Communications: Oral and Visual D, 8-10)*

*Select and use effective speaking strategies for a variety of audiences, situations and purposes.*

(Communications: Oral and Visual C, 11-12)

- *Give presentations using a variety of delivery methods, visual displays and technology.*

(Communications: Oral and Visual G, 8-10; Communications: Oral and Visual F, 11-12)

#### **BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

### **Competency 3.5: Listen and speak effectively to contribute to group discussions and meetings.**

#### **Descriptors:**

- 3.5.1 Conduct meetings in a timely, organized and professional manner.
- 3.5.2 Clarify the purpose and goals of a discussion or meeting.
- 3.5.3 Demonstrate respect for diverse cultures.
- 3.5.4 Give and receive feedback appropriately.
- 3.5.5 Stay on subject and task.
- 3.5.6 Summarize the results of the meeting, including agreements and disagreements.
- 3.5.7 Speak succinctly and clearly to convey information.

- 3.5.8 Correctly utilize transportation terminology.
- 3.5.9 Discuss slang and jargon related to different trades.
- 3.5.10 Communicate with non-English-speaking populations.

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

*Use a variety of strategies to enhance listening comprehension.* (Communications: Oral and Visual A, 8-10; Communications: Oral and Visual A, 11-12)

*Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communications: Oral and Visual C, 11-12)

*Demonstrate an understanding of effective speaking strategies by selecting appropriate language and adjusting presentation techniques.* (Communications: Oral and Visual D, 8-10)

*Give informational presentations that present ideas in a logical sequence, include relevant facts and details from multiple sources and use a consistent organizational structure.* (Communications: Oral and Visual E, 8-10)

**BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 3.6: Apply active listening skills to obtain and clarify information provided in oral communications.**

**Descriptors:**

- 3.6.1 Identify and apply active listening techniques one-to-one and in team or group meetings.
- 3.6.2 Interpret verbal cues and behaviors to enhance communication.
- 3.6.3 Interpret nonverbal cues and behaviors to enhance communication.
- 3.6.4 Paraphrase and repeat information to confirm understanding.
- 3.6.5 Record and summarize information in written notes.
- 3.6.6 Ask questions to seek or confirm understanding.

**Correlated English Language Arts Academic Content Benchmarks**

*Use a variety of strategies to enhance listening comprehension.* (Communications: Oral and Visual A, 8-10; Communications: Oral and Visual A, 11-12)

*Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communications: Oral and Visual C, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 3.7: Utilize written documents to direct the transportation systems operations.**

**Descriptors:**

- 3.7.1 Identify types of reports (e.g. quality assurance, shift turnover, schedules, preventive maintenance).

- 3.7.2 Generate work orders, including change order requests.
- 3.7.3 Calculate job cost and prepare billing documents.
- 3.7.4 Complete reports in accordance with established standards.
- 3.7.5 Apply concepts of tolerances and equivalency to specifications.
- 3.7.6 Identify the components of contract documents.
- 3.7.7 File reports with the appropriate personnel.
- 3.7.8 Disseminate written information from various sources to co-workers and clients.

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

*Apply editing strategies to eliminate slang and improve conventions.* (Writing Process D, 11-12)

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)

*Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 3.8: Research and respond to customer needs.**

**Descriptors:**

- 3.8.1 Recognize the importance of all customers to business.
- 3.8.2 Describe the relationship between meeting customer needs and profitability.
- 3.8.3 Interact with customers and vendors in a professional manner.
- 3.8.4 Demonstrate professional phone etiquette when dealing with customers, vendors and the general public.
- 3.8.5 Follow through on commitments made to customers and vendors in a timely manner.
- 3.8.6 Maintain customer satisfaction and address customer problems and complaints efficiently.

**Correlated English Language Arts Academic Content Benchmarks**

*Use a variety of strategies to enhance listening comprehension.* (Communications: Oral and Visual A, 8-10; Communications: Oral and Visual A, 11-12)

*Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communications: Oral and Visual C, 11-12)

## Correlated Mathematics Academic Content Benchmarks

*Connect statistical techniques to applications in workplace and consumer situations. (Data Analysis and Probability D, 11-12)*

### Unit 4: Problem Solving and Critical Thinking

#### BIL:Essential

EDU:	12	AD
	P	R

**Competency 4.1:Employ critical thinking and problem solving skills independently and in teams to formulate solutions to problems.**

#### Descriptors:

- 4.1.1 Define problem-solving methods accepted in the transportation industry.
- 4.1.2 State the problem completely and precisely.
- 4.1.3 Assemble and examine pertinent information.
- 4.1.4 Brainstorm potential solutions.
- 4.1.5 Identify constraints and parameters to solutions as they relate to budgets, scope and schedules.
- 4.1.6 Compare and contrast consequences, and discuss underlying assumptions.
- 4.1.7 Identify the best solution based on risks, costs, ethics, laws, benefits, conflicting concerns and points of view.
- 4.1.8 Apply the best solution to the problem.
- 4.1.9 Evaluate the solution.
- 4.1.10 Evaluate resources and timelines.

## Correlated English Language Arts Academic Content Benchmarks

*Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted. (Research A, 8-10)*

*Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted. (Research A, 11-12)*

*Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*

*Organize information from various resources and select appropriate sources to support central ideas, concepts and themes. (Research C, 8-10)*

*Evaluate the usefulness and credibility of data and sources, and synthesize information from multiple sources. (Research C, 11-12)*

*Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia. (Research E, 8-10; Research E, 11-12)*

## Correlated Mathematics Academic Content Benchmarks

*Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Patterns, Functions and Algebra D, 8-10)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable*

*solution.* (Mathematical Processes A, 8-10)

*Use precise mathematical language and notations to represent problem situations and mathematical ideas.* (Mathematical Processes F, 8-10)

*Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences.* (Mathematical Processes F, 11-12)

*Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation.* (Mathematical Processes J, 11-12)

### **Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

#### **BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

### **Competency 4.2: Apply problem solving and critical thinking techniques to the conflict between available resources, requirements of the project, and timelines.**

#### **Descriptors:**

- 4.2.1 Identify alternative solutions for a specific resources and/or materials problem.
- 4.2.2 Calculate the potential waste of resources and materials.
- 4.2.3 Examine the feasibility of each alternative suggestion.
- 4.2.4 Implement the appropriate alternative.
- 4.2.5 Use available resources and materials efficiently to complete the project.
- 4.2.6 Discuss strategies to avoid the problem in the future.

### **Correlated Mathematics Academic Content Benchmarks**

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)

*Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)

*Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)

*Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences.* (Mathematical Processes F, 11-12)

*Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation.* (Mathematical Processes J, 11-12)

### **Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.  
(Science and Technology A, 9-10)*

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 4.3: Combine critical thinking and team-building skills to solve problems.**

**Descriptors:**

- 4.3.1 Work with others to define problems.
- 4.3.2 Share ideas, facts, information and/or data with others.
- 4.3.3 State personal positions clearly, and respect conflicting positions.
- 4.3.4 Accept and support group decisions even when different from a personal solution, within the bounds of ethical, safety, legal or similar concerns.

**Correlated English Language Arts Academic Content Benchmarks**

*Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 8-10; Research E, 11-12)  
*Use a variety of strategies to enhance listening comprehension.* (Communications: Oral and Visual A, 8-10; Communications: Oral and Visual A, 11-12)  
*Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communications: Oral and Visual C, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)  
*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)  
*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 4.4: Evaluate and adjust plans and schedules to respond to unexpected events and conditions.**

**Descriptors:**

- 4.4.1 Identify potential events and conditions that disrupt the completion of a job.
- 4.4.2 Incorporate potential job disruptions into planning timelines.
- 4.4.3 Solve situational problems involved with unexpected events and conditions.
- 4.4.4 Identify and assess critical situations, and implement an appropriate response.
- 4.4.5 Adjust plans and schedules to reflect an unexpected change.
- 4.4.6 Provide a project update to track change.

**Correlated English Language Arts Academic Content Benchmarks**

*Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted. (Research A, 8-10)*

*Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted. (Research A, 11-12)*

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources. (Research C, 11-12)*

### **Correlated Mathematics Academic Content Benchmarks**

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number, Number Sense and Operations G, 8-10)*

*Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions. (Measurement F, 8-10)*

*Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Patterns, Functions and Algebra D, 8-10)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 11-12)*

#### **BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

### **Competency 4.5: Apply mathematical principles and formulas to transportation systems problems.**

#### **Descriptors:**

4.5.1 Utilize statistical probability to address problems.

4.5.2 Apply statistical process control to operational problems.

### **Correlated Mathematics Academic Content Benchmarks**

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number, Number Sense and Operations G, 8-10)*

*Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions. (Measurement F, 8-10)*

*Use counting techniques, such as permutations and combinations, to determine the total number of options and possible outcomes. (Data Analysis and Probability H, 8-10)*

*Design an experiment to test a theoretical probability, and record and explain results. (Data Analysis and Probability I, 8-10)*

*Compute probabilities of compound events, independent events, and simple dependent events.*

*(Data Analysis and Probability J, 8-10)*

*Make predictions based on theoretical probabilities and experimental results. (Data Analysis and Probability K, 8-10)*

*Connect statistical techniques to applications in workplace and consumer situations. (Data Analysis and Probability D, 11-12)*

#### **BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 4.6: Apply scientific theory and applications to transportation systems problems.**

**Descriptors:**

- 4.6.1 Identify situations that require scientific theory and application.
- 4.6.2 Utilize physical sciences and applications to address problems.

**Correlated Science Academic Content Benchmarks**

*Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. (Scientific Ways of Knowing A, 9-10)*

*Explain the ways in which the processes of technological design respond to the needs of society. (Science and Technology A, 9-10)*

*Explain the movement of objects by applying Newton’s three laws of motion. (Physical Sciences D, 9-10)*

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems. (Physical Sciences D, 11-12)*

**Unit 5: Leadership and Teamwork**

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 5.1: Summarize the interpersonal skills that contribute to positive leadership and teamwork.**

**Descriptors:**

- 5.1.1 Identify and explain basic interpersonal skills most closely associated with a positive work environment (e.g., empathy, listening, respect, unconditional positive regard).
- 5.1.2 Discuss the importance of relating to the culture and climate of an organization.
- 5.1.3 Identify the variety of cultural diversity in the workplace (e.g., race, religion, nationality, gender).
- 5.1.4 Discuss cultural diversity issues related to business.

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 5.2: Demonstrate the ability to work on a team and recognize the importance of teamwork and its impact on business in a transportation environment.**

**Descriptors:**

- 5.2.1 Define teamwork and team goals and objectives.
- 5.2.2 Identify types of teams (e.g. cross-functional, cross-trained).
- 5.2.3 Describe the role of effective teams in high-performance workplaces.
- 5.2.4 Examine unique issues associated with working on teams.
- 5.2.5 Apply team problem-solving and conflict-resolution practices.

- 5.2.6 Explain the roles and responsibilities of the individual as part of the team.
- 5.2.7 Identify attitudes and behaviors that promote positive interaction between members of the work team (e.g., punctuality, attendance, preparedness).

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

*Use a variety of strategies to enhance listening comprehension.* (Communications: Oral and Visual A, 8-10; Communications: Oral and Visual A, 11-12)

*Select and use effective speaking strategies for a variety of audiences, situations and purposes.*

(Communications: Oral and Visual C, 11-12)

**BIL:Essential**

EDU:	12	AD
	P	R

**Competency 5.3: Perform responsibly as a team member.**

**Descriptors:**

- 5.3.1 Organize and schedule dependent team assignments.
- 5.3.2 Demonstrate an organized team approach to accomplishing tasks.
- 5.3.3 Assist other members of the work team.
- 5.3.4 Discuss typical safety situations encountered where teamwork is essential.
- 5.3.5 Describe the importance of accountability for roles and responsibilities.
- 5.3.6 Identify the basic psychological needs that motivate behavior (e.g., belonging, power, freedom).
- 5.3.7 Discuss the role that different values play in generating conflict.
- 5.3.8 Identify how the effects of substance abuse, mental health and disabilities impact conflict.

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 5.4: Use motivational techniques to enhance performance in others.**

**Descriptors:**

- 5.4.1 Describe the induction process new employees experience when they enter a new work group.
- 5.4.2 Discuss communication barriers new employees may encounter.
- 5.4.3 Use reward and incentive systems.
- 5.4.4 Coach associates to expand their role within the transportation organization.
- 5.4.5 Use coaching skills to inspire others to achieve.
- 5.4.6 Explain the importance of progressive disciplinary action to improve performance.

**Correlated English Language Arts Academic Content Benchmarks**

*Use a variety of strategies to enhance listening comprehension.* (Communications: Oral and Visual A, 8-10; Communications: Oral and Visual A, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 5.5: Examine the different responses to conflict as they relate to results.**

**Descriptors:**

- 5.5.1 Describe the soft response approach (e.g. avoidance, compromise and accommodation) and the typical reasons for using that approach.
- 5.5.2 Describe the soft response approach (e.g. avoidance, compromise and accommodation) and the typical reasons for using that approach.
- 5.5.3 Describe the hard response approach (e.g. force, threats, aggression and anger) and the typical reasons for using that approach
- 5.5.4 Describe the principled response approach (e.g. good communication skills, problem solving skills, and the ability to see the problem from more than one perspective) and the typical reasons for using that approach.

**BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 5.6: Resolve conflicts to maintain a smooth workflow.**

**Descriptors:**

- 5.6.1 Use conflict resolution skills.
- 5.6.2 Work collaboratively and cooperatively.
- 5.6.3 Give and receive criticism in a diplomatic and constructive manner.
- 5.6.4 Use diplomatic and constructive statements and responses.
- 5.6.5 Manage stress and control emotions.
- 5.6.6 Convey honesty and integrity when providing feedback to associates.

**Correlated English Language Arts Academic Content Benchmarks**

*Use a variety of strategies to enhance listening comprehension.* (Communications: Oral and Visual A, 8-10; Communications: Oral and Visual A, 11-12)

*Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communications: Oral and Visual C, 11-12)

**Unit 6: Legal and Ethical Aspects**

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 6.1: Differentiate between legal and ethical issues.**

**Descriptors:**

- 6.1.1 Define “legal” and “ethical” issues.
- 6.1.2 Translate legal and ethical issues to the transportation industry.
- 6.1.3 Define and distinguish between company and departmental policies.

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary. (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)*

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 6.2: Complete work-related duties within an ethical framework.**

**Descriptors:**

- 6.2.1 Identify codes of ethics within the professions.
- 6.2.2 Develop an individual ethical framework.
- 6.2.3 Demonstrate ethical behavior when interacting with colleagues both internal and external to the profession.
- 6.2.4 Describe the ethical impact of positive cultural sensitivity in a transportation organization.

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 6.3: Assess the implications of ethical and unethical behavior.**

**Descriptors:**

- 6.3.1 Compare and contrast personal, professional and organizational ethics.
- 6.3.2 Demonstrate respect for the property of customers, other professions and coworkers.
- 6.3.3 Resolve issues relating to any potential conflicts of interest between personal and organizational ethics.
- 6.3.4 Identify strategies for responding to the unethical actions of individuals and organizations.
- 6.3.5 Identify the ramifications of unethical actions.

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 6.4: Perform duties according to laws, regulations, contract provisions and policies.**

**Descriptors:**

- 6.4.1 Describe the legal responsibilities, limitations and implications of actions.

- 6.4.2 Comply with the legal responsibilities specified by state practice act(s) and other pertinent legislation.
- 6.4.3 Compare and contrast the roles of various regulatory agencies (e.g. content of laws and regulation of jurisdictions).
- 6.4.4 Identify the types of contracts and describe their roles in the transportation industry.
- 6.4.5 Illustrate how work activities relate to health and safety issues.

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 6.5: Comply with applicable governmental regulations and codes.**

**Descriptors:**

- 6.5.1 Identify governmental regulations and codes.
- 6.5.2 Describe mandated standards for workplace safety, harassment, labor and employment laws.
- 6.5.3 Identify personal and organizational ramifications for failure to comply with government laws and regulations.
- 6.5.4 Describe the interrelationships between local and national codes.
- 6.5.5 Identify legal responsibilities specified by state practice act(s) and other pertinent legislation (e.g., substance abuse, harassment, discrimination).
- 6.5.6 Identify legal responsibilities specified by state practice act(s), other pertinent legislation and regulatory agencies as it relates to union and/or non-union practices.
- 6.5.7 Apply regulations and codes according to guidelines.
- 6.5.8 Complete job inspections and adhere to all regulations and codes.

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

*Apply reading comprehension strategies to understand grade-appropriate texts.* (Reading Process A, 8-10; Reading Process A, 11-12)

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data Analysis and Probability A, 11-12)*

*Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data Analysis and Probability B, 11-12)*

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 6.6: Explain employee and employer liability (e.g., monetary and personal).**

**Descriptors:**

- 6.6.1 Define liability and negligence.
- 6.6.2 Discuss protections against liability.
- 6.6.3 Explain the role of the Bureau of Workers' Compensation in workplace injuries.
- 6.6.4 Discuss the concept of transferring risk.
- 6.6.5 Describe the "multi-employer" responsibility under Department of Transportation (DOT), Federal Motor Carrier Safety Administration (FMCSA) and OSHA.

**Correlated English Language Arts Academic Content Benchmarks**

*Use context clues and text structures to determine the meaning of new vocabulary. (Acquisition of Vocabulary A, 8-10)*

*Use multiple resources to enhance comprehension of vocabulary. (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)*

## **Unit 7: Information Technology Applications**

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 7.1: Use computer-based technology.**

**Descriptors:**

- 7.1.1 Access a Web site using the Internet.
- 7.1.2 Use e-mail to send and receive messages.
- 7.1.3 Collect data from the environment, people or instruments.
- 7.1.4 Use electronic sources to determine the quality, relevance or usefulness of a product.
- 7.1.5 Use electronic sources to generate and access client or customer information for evaluation.
- 7.1.6 Use a database to summarize, compare and contrast information.
- 7.1.7 Represent existing client, product, service or topical information in a different form.
- 7.1.8 Interpret client or product information to determine appropriate action.

**Correlated English Language Arts Academic Content Benchmarks**

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources. (Research C, 11-12)*

**Correlated Mathematics Academic Content Benchmarks**

*Translate information from one representation (words, table, graph or equation) to another representation of a relation or function. (Patterns, Functions and Algebra C, 8-10)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data Analysis and Probability A, 11-12)*

*Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data Analysis and Probability B, 11-12)*

### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

### **Competency 7.2: Employ information technology applications.**

#### **Descriptors:**

- 7.2.1 Identify organizational policies and ethics regarding the use of communications tools.
- 7.2.2 Use personal information management (PIM) productivity applications (e.g., schedules, contacts, memos).
- 7.2.3 Communicate using electronic equipment (e.g. e-mail, fax, phone).
- 7.2.4 Utilize Internet applications.
- 7.2.5 Utilize writing and publishing applications.
- 7.2.6 Prepare reports and other business communications integrating graphics and other non-text elements.
- 7.2.7 Demonstrate presentation applications.
- 7.2.8 Utilize spreadsheets and database applications.
- 7.2.9 Employ collaborative and groupware applications.
- 7.2.10 Examine computer-driven equipment and machines, and access support as needed.

### **Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary. (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)*

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)*

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

*Give presentations using a variety of delivery methods, visual displays and technology. (Communications: Oral and Visual G, 8-10; Communications: Oral and Visual F, 11-12)*

### **Correlated Mathematics Academic Content Benchmarks**

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data Analysis and Probability A, 11-12)*

*Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data Analysis and Probability B, 11-12)*

*Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. (Data Analysis and Probability C, 11-12)*

12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 7.3: Use geographic information systems.**

**Descriptors:**

- 7.3.1 Represent data on maps using Global Positioning System and Geographic Information Systems (GPS and GIS) software.
- 7.3.2 Locate physical addresses on maps using GPS and GIS software.
- 7.3.3 Estimate distances and travel times between two or more locations.
- 7.3.4 Utilize GPS and GIS software to produce and print maps.

**Correlated Mathematics Academic Content Benchmarks**

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)

*Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)

**Unit 8: Safety, Health and Environmental Aspects**

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 8.1: Maintain general safety in accordance with government regulations, health standards, company policy, procedure and practices.**

**Descriptors:**

- 8.1.1 Wear personal protective equipment (PPE) as appropriate (e.g., dust mask, hearing protection, respirators, eye protection).
- 8.1.2 Check and correct potential hazards (e.g., hair, jewelry, clothing).
- 8.1.3 Maintain personal protective equipment (e.g., inspect, clean, replace).
- 8.1.4 Follow established procedures for the use of safety apparatus and equipment, including fall protection.
- 8.1.5 Conduct routine building safety inspections.
- 8.1.6 Check power sources for potential hazards, and confirm proper grounding.
- 8.1.7 Shut down power equipment in dangerous situations using disconnect switches and established lock-out/tag-out (LO/TO) procedures.
- 8.1.8 Identify the location of emergency flush showers, eye wash fountains, fire alarms and exits.
- 8.1.9 Maintain work areas in accordance with standards for cleanliness and safety.
- 8.1.10 Describe how to operate fire extinguishers, and identify classes of fires.
- 8.1.11 Inspect air and exhaust systems, including intake filters, fans and other mechanical components.
- 8.1.12 Explain the value of an emergency response plan.

**Correlated English Language Arts Academic Content Benchmarks**

Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision. (Measurement E, 8-10)

Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability. (Data Analysis and Probability A, 8-10)

Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations. (Scientific Inquiry A, 9-10)

Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data. (Scientific Inquiry A, 11-12)

**BIL:Essential**

EDU:	12	AD
	P	R

**Competency 8.2: Evaluate the human and ergonomic factors associated with the transportation industry.**

**Descriptors:**

- 8.2.1 Wear personal protective equipment (PPE) in accordance with the ergonomic process.
- 8.2.2 Define ergonomics.
- 8.2.3 Describe ergonomic factors of the workplace.
- 8.2.4 Identify work associated with repetitive motion, as well as lifting or moving heavy objects.
- 8.2.5 Demonstrate appropriate body mechanics in lifting and moving heavy objects.
- 8.2.6 Describe the ergonomic importance of properly operating various types of tools and equipment.

**Correlated English Language Arts Academic Content Benchmarks**

Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Acquisition of Vocabulary D, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision. (Measurement E, 8-10)

Describe sampling methods and analyze the effects of method chosen on how well the resulting sample represents the population. (Data Analysis and Probability G, 8-10)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 8.3: Identify state, federal, and local worker safety, health and environmental regulations.**

**Descriptors:**

- 8.3.1 Examine the Occupational Safety and Health Administration (OSHA) and Federal Aviation Administration (FAA) regulations.
- 8.3.2 Examine the state Bureau of Workers' Compensation (BWC).
- 8.3.3 Explain workers' compensation cost as it relates to transportation.
- 8.3.4 Describe the purpose of the National Institute for Occupational Safety and Health (NIOSH).
- 8.3.5 Identify safety documentation.
- 8.3.6 Discuss applicable international regulations that impact transportation operations.
- 8.3.7 Discuss the Ohio and Federal Environmental Protection Agency (EPA) regulations.
- 8.3.8 Describe the industry-specific governmental regulatory agencies (e.g., Department of Transportation [DOT]).
- 8.3.9 Interpret personal safety rights according to employee's right-to-know plans and hazardous communications.
- 8.3.10 Interpret material safety data sheets (MSDS), and use materials accordingly.

**Correlated English Language Arts Academic Content Benchmarks**

*Use context clues and text structures to determine the meaning of new vocabulary.* (Acquisition of Vocabulary A, 8-10)

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

*Evaluate how features and characteristics make information accessible and usable and how structures help authors achieve their purposes.* (Reading: Informational, Technical and Persuasive Text A, 8-10)

**Correlated Mathematics Academic Content Benchmarks**

*Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.* (Scientific Inquiry A, 9-10)

*Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.* (Scientific Inquiry A, 11-12)

**BIL: Essential**

EDU:	12	AD
	I	P

**Competency 8.4: Demonstrate practices that contribute to a safe workplace environment.**

**Descriptors:**

- 8.4.1 Identify unsafe operations of a process.
- 8.4.2 Establish safety training meetings with relevant topics.

- 8.4.3 Explain the concept of “engineering out” as a personal protection strategy.
- 8.4.4 Conduct and participate in accident and other incident investigations.
- 8.4.5 Perform a job safety analysis (JSA).
- 8.4.6 Inform and correct unsafe activities committed by coworkers.
- 8.4.7 Examine access and egress procedures.
- 8.4.8 Employ ergonomic concepts in daily work activities.

**Correlated English Language Arts Academic Content Benchmarks**

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.* (Scientific Inquiry A, 9-10)

*Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.* (Scientific Inquiry A, 11-12)

**BIL: Recommended**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	R

**Competency 8.5: Complete the requirements for first aid and CPR certification.**

**Descriptors:**

- 8.5.1 Complete first aid training and certification.
- 8.5.2 Complete cardiopulmonary resuscitation (CPR) training and certification.

**Correlated English Language Arts Academic Content Benchmarks**

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 8.6: Complete and apply operations and safety training on pertinent equipment.**

**Descriptors:**

- 8.6.1 Complete orientation to pertinent equipment before operating.
- 8.6.2 Review all important information regarding equipment safety.
- 8.6.3 Utilize the correct tools to do the job during training.

- 8.6.4 Conduct a post-training evaluation to assure the equipment is operated safely.
- 8.6.5 Document the quality and effectiveness of the training.
- 8.6.6 Fulfill safety and health requirements for maintenance.
- 8.6.7 Monitor and operate equipment in compliance with both company and national regulations.

**Correlated English Language Arts Academic Content Benchmarks**

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 8.7: Identify practices that contribute to a healthy environment.**

**Descriptors:**

- 8.7.1 Discuss symptoms of exposure to health-threatening environments (e.g., temperature; chemicals; noise, vibrations, harshness [NVH]; biological hazards).
- 8.7.2 Describe the effects of hazardous activities (e.g., welding).
- 8.7.3 Describe precautions required when using toxic or flammable materials.
- 8.7.4 Discuss the inspection of air and exhaust systems, including intake filters, fans and other mechanical components.
- 8.7.5 Describe the interactions of incompatible substances.
- 8.7.6 Describe basic health and hygiene principles.

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 8.8: Handle hazardous materials in accordance with government regulations and health standards.**

**Descriptors:**

- 8.8.1 Identify types of hazardous materials (e.g., chemical, biological).
- 8.8.2 Interpret container label precautions.
- 8.8.3 Identify hazardous storage procedures in compliance with government regulations.
- 8.8.4 Dispose of hazardous materials in accordance with government regulations.
- 8.8.5 Examine a hazardous materials safety plan.

**Correlated English Language Arts Academic Content Benchmarks**

*Apply reading comprehension strategies to understand grade-appropriate texts.* (Reading Process A, 8-10; Reading Process A, 11-12)

**Correlated Science Academic Content Benchmarks**

*Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.* (Scientific Inquiry A, 9-10)

*Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data. (Scientific Inquiry A, 11-12)*

**BIL: Essential**

EDU:	12	AD
	I	P

**Competency 8.9: Analyze regulations for transporting hazardous materials.**

**Descriptors:**

- 8.9.1 Describe the United Nations (UN) and North American (NA) shipping documents.
- 8.9.2 Explain the function of placards and labeling.
- 8.9.3 Describe the manifest and explain its function.
- 8.9.4 Discuss handling and loading procedures.
- 8.9.5 Describe the procedures for emergency response and cleanup.
- 8.9.6 Identify and explain the security regulations and precautions.
- 8.9.7 Identify potential transportation threats and the appropriate reporting authorities.

**Correlated English Language Arts Academic Content Benchmarks**

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)*

*Evaluate how features and characteristics make information accessible and usable and how structures help authors achieve their purposes. (Reading: Informational, Technical and Persuasive Text A, 8-10)*

## **Unit 9: Transportation Fuels**

**BIL: Recommended**

EDU:	12	AD
	I	P

**Competency 9.1 Discuss the historical and economic impact of the petroleum industry.**

**Descriptors:**

- 9.1.1 Discuss historical and current events related to the petroleum industry.
- 9.1.2 Discuss the impact of the petroleum industry on environmental factors.
- 9.1.3 Discuss the economic impact of the petroleum industry.

**Correlated English Language Arts Academic Content Benchmarks**

*Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)*

**Correlated Mathematics Academic Content Benchmarks**

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data Analysis and Probability A, 11-12)*

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific*

audience. (Mathematical Processes I, 11-12)

### **Correlated Science Academic Content Benchmarks**

*Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources. (Earth and Space Sciences D, 9-10)*

*Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future. (Earth and Space Sciences C, 11-12)*

*Describe how human activities can impact the status of natural systems. (Life Sciences G, 9-10)*

*Explain how human choices today will affect the quality and quantity of life on earth. (Life Sciences F, 11-12)*

*Describe how atoms and molecules can gain or lose energy only in discrete amounts. (Physical Sciences C, 11-12)*

*Explain that science and technology are interdependent; each drives the other. (Science and Technology B, 9-10)*

*Predict how human choices today will determine the quality and quantity of life on Earth. (Science and Technology A, 11-12)*

### **BIL: Recommended**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

### **Competency 9.2: Discuss the alternative vehicular fuel industry.**

#### **Descriptors:**

9.2.1 Discuss the history of the alternative fuel industry.

9.2.2 Identify driving forces in the move to alternative fuel solutions.

9.2.3 Discuss local, state and national legislation related to alternative vehicular fuels.

### **Correlated English Language Arts Academic Content Benchmarks**

*Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)*

*Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*

### **Correlated Mathematics Academic Content Benchmarks**

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data Analysis and Probability A, 11-12)*

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 11-12)*

### **Correlated Science Academic Content Benchmarks**

*Predict how human choices today will determine the quality and quantity of life on Earth. (Science and Technology A, 11-12)*

*Explain how societal issues and considerations affect the progress of science and technology. (Scientific Ways of Knowing C, 11-12)*

### **BIL:Recommended**

EDU:	12	AD
	I	P

**Competency 9.3 Compare and contrast viable fuels.**

**Descriptors:**

- 9.3.1 Discuss the concept of well-to-wheel.
- 9.3.2 Identify various viable fuels.
- 9.3.3 Discuss the environmental impact of each fuel source.
- 9.3.4 Discuss emission characteristics of each fuel source.
- 9.3.5 Compare the economic viability of each fuel source depending on the application life cycle.
- 9.3.6 Calculate costs and benefits of various alternative fuels.

**Correlated Mathematics Academic Content Benchmarks**

*Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Patterns, Functions and Algebra D, 8-10)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data Analysis and Probability A, 11-12)*

*Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data Analysis and Probability B, 11-12)*

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Mathematical Processes H, 8-10)*

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 11-12)*

**Correlated Science Academic Content Benchmarks**

*Predict how human choices today will determine the quality and quantity of life on Earth. (Science and Technology A, 11-12)*

**BIL:Recommended**

EDU:	12	AD
	I	P

**Competency 9.4 Discuss engine modification related to the use of alternative fuels.**

**Descriptors:**

- 9.4.1 Identify the modifications to current vehicles that are required for burning alternative fuels.
- 9.4.2 Discuss idle reduction technology.
- 9.4.3 Discuss safety issues related to various vehicular fuels.

**Correlated Mathematics Academic Content Benchmarks**

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Mathematical Processes H, 8-10)*

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.*  
(Science and Technology A, 9-10)

**BIL: Recommended**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 9.5 Discuss future vehicular fuel sources.**

**Descriptor:**

- 9.5.1 Discuss current research in future vehicular fuel sources.
- 9.5.2 Identify costs, benefits and the environmental impact of future vehicular fuel sources.

**Correlated English Language Arts Academic Content Benchmarks**

*Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

*Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

*Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability.* (Data Analysis and Probability B, 11-12)

*Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)

*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

**Correlated Science Academic Content Benchmarks**

*Explain that science and technology are interdependent; each drives the other.* (Science and Technology B, 9-10)

*Predict how human choices today will determine the quality and quantity of life on Earth.*  
(Science and Technology A, 11-12)

**Unit 10: Transportation Systems Technical Skills Sets**

**BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 10.1: Explore the performance skills of an automotive technician.**

**Descriptors:**

- 10.1.1 Identify the role and function of an automotive technician.
- 10.1.2 Identify the areas of specialization and related occupations.
- 10.1.3 Explore the types of work techniques, processes and procedures a typical automotive technician might be called upon to perform.
- 10.1.4 Describe the education, training and certification required to work as an automotive technician.

**Correlated English Language Arts Academic Content Benchmarks**

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 10.2: Explore the performance skills of a medium and heavy transportation technician.****Descriptors:**

- 10.2.1 Identify the role and function of a medium and heavy transportation technician.
- 10.2.2 Identify the areas of specialization and related occupations.
- 10.2.3 Explore the types of work techniques, processes and procedures a typical medium and heavy transportation technician might be called upon to perform.
- 10.2.4 Describe the education, training and certification required to work as a medium and heavy transportation technician.

**Correlated English Language Arts Academic Content Benchmarks**

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 10.3: Explore the performance skills of a collision repair technician.****Descriptors:**

- 10.3.1 Identify the role and function of a collision repair technician.
- 10.3.2 Identify the areas of specialization and related occupations.
- 10.3.3 Explore the types of work techniques, processes and procedures a typical collision repair technician might be called upon to perform.
- 10.3.4 Describe the education, training and certification required to work as a collision repair technician.

**Correlated English Language Arts Academic Content Benchmarks**

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 10.4: Explore the performance skills of an aviation maintenance technician.**

**Descriptors:**

- 10.4.1 Identify the role and function of an aviation maintenance technician.
- 10.4.2 Identify the areas of specialization and related occupations.
- 10.4.3 Explore the types of work techniques, processes and procedures a typical aviation maintenance technician might be called upon to perform.
- 10.4.4 Describe the education, training and certification required to work as an aviation maintenance technician.

**Correlated English Language Arts Academic Content Benchmarks**

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 10.5: Explore the performance skills of an aviation technology employee.**

**Descriptors:**

- 10.5.1 Identify the role and function of an aviation technology employee.
- 10.5.2 Identify the areas of specialization and related occupations.
- 10.5.3 Explore the types of work techniques, processes and procedures a typical aviation technology employee might be called upon to perform.
- 10.5.4 Describe the education, training and certification required to work as an aviation technology employee.

**Correlated English Language Arts Academic Content Benchmarks**

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 10.7: Explore the performance skills of a power equipment technician.**

**Descriptors:**

- 10.7.1 Identify the role and function of a power equipment technician.
- 10.7.2 Identify the areas of specialization and related occupations.
- 10.7.3 Explore the types of work techniques, processes and procedures a typical power equipment

10.7.4 technician might be called upon to perform.  
Describe the education, training and certification required to work as a power equipment technician.

**Correlated English Language Arts Academic Content Benchmarks**

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

# Automotive Technician

The National Automotive Technicians Education Foundation (NATEF) Standards recognize that program content requirements vary by program type and by regional employment needs. Therefore, flexibility has been built into the NATEF task list of competencies and descriptors by assigning each task (competency and descriptor) a priority number. The priority number indicates the minimum percentage of the listed tasks (competencies and descriptors) that a program must include in order to be certified in each content area. The following guidelines must be followed:  
Ninety-five percent (95%) of all Priority 1 (P-1) items must be taught in the curriculum;  
Eighty percent (80%) of all Priority 2 (P-2) items must be taught in the curriculum; and  
Fifty percent (50%) of all Priority 3 (P-3) items must be taught in the curriculum.

## Unit 11:Orientation to the Automotive Industry

### BIL:Essential

EDU:	12	AD
	P	R

### Competency 1.1: Define the industry

#### Descriptors:

- 11.1.1 Present an overview of the automotive industry (e.g., auto manufacturers, service contracts, sales, alternative fuel systems and their performance characteristics).
- 11.1.2 Identify the professional and/or trade associations related to the automotive industry.
- 11.1.3 Identify areas of specialization and related occupations within the automotive industry.
- 11.1.4 Identify the employment opportunities in the automotive industry.

### Correlated English Language Arts Academic Content Benchmarks

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)*  
*Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*

### BIL:Essential

EDU:	12	AD
	P	R

### Competency 11.2 Determine the skills needed to work in the automotive industry.

#### Descriptors:

- 11.2.1 Match automotive occupational job titles with qualifications and responsibilities.
- 11.2.2 Identify the education, training, and certification required to work in the various automotive careers.
- 11.2.3 Describe the kinds of work techniques, processes and procedures a typical automotive industry professional might be called upon to use.
- 11.2.4 Identify and utilize information gathering techniques (e.g., computer-based information, printed sources).

### Correlated English Language Arts Academic Content Benchmarks

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)*  
*Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*  
*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources. (Research C, 11-12)*

**Correlated Mathematics Academic Content Benchmarks**

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number, Number Sense and Operations G, 8-10)*  
*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 11-12)*

**Unit 12: Tools and Equipment**

**BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 12.1: Identify basic tools and equipment appropriate to the automotive industry.**

**Descriptors:**

- 12.1.1 Identify the various types of tools and equipment applicable to automotive applications.
- 12.1.2 Describe the primary functions of various types of hand and power tools.
- 12.1.3 Discuss ergonomic issues in the design and use of tools and equipment.

**Correlated English Language Arts Academic Content Benchmarks**

*Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Acquisition of Vocabulary D, 11-12)*  
*Use multiple resources to enhance comprehension of vocabulary. (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)*

**BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	P	R

**Competency 12.2: Demonstrate the appropriate use of basic hand tools to complete work functions.**

**Descriptors:**

- 12.2.1 Identify potential hazards and limitations related to the use of tools.
- 12.2.2 Demonstrate basic measuring tools.
- 12.2.3 Use tools in accordance with established procedures and safety standards.

**Correlated Mathematics Academic Content Benchmarks**

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number, Number Sense and Operations G, 8-10)*  
*Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 11-12)*

**BIL:Essential**

EDU:	12	AD
	P	R

**Competency 12.3: Operate power tools and stationary equipment.**

**Descriptors:**

- 12.3.1 Identify types of power tools and stationary equipment and their functions in transportation.
- 12.3.2 Match the appropriate power tools and stationary equipment for a given task.
- 12.3.3 Operate power tools and stationary equipment in accordance with established procedures and safety standards.

**BIL:Essential**

EDU:	12	AD
	P	R

**Competency 12.4: Maintain hand and power tools appropriate to the automotive industry.**

**Descriptors:**

- 12.4.1 Conduct routine inspections and audits of hand tools and power equipment.
- 12.4.2 Troubleshoot maintenance problems in accordance with established procedures.
- 12.4.3 Perform preventive maintenance in accordance with guidelines specified by the manufacturer and/or outside authorities with jurisdiction (e.g., OSHA).
- 12.4.4 Describe the certifications for operating specific tools.

**Correlated English Language Arts Academic Content Benchmarks**

*Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

*Evaluate how features and characteristics make information accessible and usable and how structures help authors achieve their purposes.* (Reading: Informational, Technical and Persuasive Text A, 8-10)

**BIL:Essential**

EDU:	12	AD
	P	R

**Competency 12.5: Use appropriate personal protective equipment (PPE).**

**Descriptors:**

- 12.5.1 Identify the appropriate personal protective equipment (PPE) to wear with specific automotive, and identify the consequences of non-compliance.
- 12.5.2 Discuss various conditions that workers encounter, and match the appropriate PPE to each situation.
- 12.5.3 Demonstrate and practice proper fit, use of each type and care of PPE.

**Correlated Science Academic Content Benchmarks**

*Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations. (Scientific Inquiry A, 9-10)*

*Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data. (Scientific Inquiry A, 11-12)*

## **Unit 13:Engine Repair**

**Note:** Throughout Unit 13, students are expected to learn and use vocabulary specific to the automotive technician career field. Correlations to the English Language Arts **Acquisition of Vocabulary** standards include the following benchmarks:

*Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Acquisition of Vocabulary D, 11-12); and*

*Use multiple resources to enhance comprehension of vocabulary. (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12).*

### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

### **Competency 13.1: Perform general engine diagnosis, removal and reinstallation (R&R).**

#### **Descriptors:**

- 13.1.1 Complete a work order to include customer information, vehicle identifying information, customer concern, related service history, cause and correction [P-1].
- 13.1.2 Identify and interpret an engine concern; determine necessary action [P-1].
- 13.1.3 Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions and technical service bulletins [P-1].
- 13.1.4 Locate and interpret vehicle and major component identification numbers (i.e., VIN, vehicle certification labels and calibration decals) [P-1].
- 13.1.5 Inspect engine assembly for fuel, oil, coolant and other leaks; determine necessary action [P-1].
- 13.1.6 Diagnose engine noises and vibrations; determine necessary action [P-2].
- 13.1.7 Diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor and sound; determine necessary action [P-2].
- 13.1.8 Perform engine vacuum tests; determine necessary action [P-1].
- 13.1.9 Perform cylinder power balance tests; determine necessary action [P-1].
- 13.1.10 Perform cylinder cranking compression tests; determine necessary action [P-1].
- 13.1.11 Perform cylinder leakage tests; determine necessary action [P-1].
- 13.1.12 Remove and reinstall the engine in a front wheel or rear wheel drive vehicle (OBDII or newer); reconnect all attaching components and restore the vehicle to running condition [P-2].
- 13.1.13 Install engine covers using gaskets, seals and sealers as required [P-1].

#### **Correlated English Language Arts Academic Content Benchmarks**

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.*

(Research C, 11-12)

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

### BIL:Essential

EDU:	12	AD
	I	P

### Competency 13.2: Perform cylinder head and valve train diagnosis and repair.

#### Descriptors:

- 13.2.1 Remove and reinstall cylinder heads and gaskets; tighten according to manufacturer's specifications and procedures [P-1].
- 13.2.2 Visually inspect cylinder head(s) for cracks; check gasket surface areas for warpage and leakage; check passage condition [P-2].
- 13.2.3 Inspect valve springs for squareness and free height comparison; determine necessary action [P-3].
- 13.2.4 Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks and valve grooves; determine necessary action [P-2].
- 13.2.5 Inspect valve guides for wear; check valve stem-to-guide clearance; determine necessary action [P-3].
- 13.2.6 Inspect valves and valve seats; determine necessary action [P-3].
- 13.2.7 Check valve face-to-seat contact and valve seat concentricity (runout); determine necessary action [P-3].
- 13.2.8 Check valve spring assembled height and valve stem height; determine necessary action [P-3].
- 13.2.9 Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary actions [P-2].
- 13.2.10 Inspect hydraulic or mechanical lifters; determine necessary action [P-2].
- 13.2.11 Adjust valves (mechanical or hydraulic lifters) [P-1].
- 13.2.12 Inspect camshaft drives, including gear wear and backlash, sprocket and chain wear; determine necessary action [P-2].
- 13.2.13 Inspect and replace timing belts (chains), overhead camdrive sprockets and tensioners; check belt or chain tension; adjust as necessary [P-1].
- 13.2.14 Inspect camshaft for runout, journal wear and lobe wear [P-2].
- 13.2.15 Inspect camshaft bearing surface for wear, damage, out-of-round and alignment; determine necessary action [P-3].

13.2.16 Establish camshaft(s) timing and cam sensor indexing according to manufacturer's specifications and procedures [P-1].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 13.3: Perform engine block assembly diagnosis and repair.**

**Descriptors:**

- 13.3.1 Disassemble engine block; clean and prepare components for inspection and reassembly according to manufacturer's service procedures [P-2].
- 13.3.2 Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action [P-1].
- 13.3.3 Perform common fastener and thread repair, to include removing a broken bolt, restoring internal and external threads, and repairing internal threads with a thread insert [P-1].
- 13.3.4 Inspect and measure cylinder walls and sleeves for damage, wear and ridges; determine necessary action [P-2].
- 13.3.5 Deglaze and clean cylinder walls [P-2].
- 13.3.6 Inspect and measure camshaft bearings for wear, damage, out-of-round and alignment; determine necessary action [P-3].
- 13.3.7 Inspect crankshaft for end play, straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure journal wear; check crankshaft sensor reluctor ring (where applicable); determine necessary action [P-2].
- 13.3.8 Inspect main and connecting rod bearings for damage and wear; determine necessary action [P-2].
- 13.3.9 Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine necessary action [P-3].
- 13.3.10 Inspect and measure pistons; determine necessary action [P-2].
- 13.3.11 Remove and replace a piston pin [P-3].
- 13.3.12 Inspect, measure and install piston rings [P-2].

- 13.3.13 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].
- 13.3.14 Inspect or replace crankshaft vibration damper (harmonic balancer) [P-3].
- 13.3.15 Assemble engine block assembly [P-1].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 13.4: Perform lubrication and cooling systems diagnosis and repair.**

**Descriptors:**

- 13.4.1 Perform oil pressure tests; determine necessary action [P-1].
- 13.4.2 Inspect oil pump gears or rotors, housing, pressure relief devices and pump drive; perform necessary action [P-2].
- 13.4.3 Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank and hoses; determine necessary action [P-1].
- 13.4.4 Inspect, replace and adjust drive belts, tensioners and pulleys; check pulley and belt alignment [P-1].
- 13.4.5 Inspect and replace engine cooling and heater system hoses [P-1].
- 13.4.6 Inspect, test and replace thermostat and gasket [P-1].
- 13.4.7 Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required [P-1].
- 13.4.8 Inspect, test, remove and replace water pump [P-1].
- 13.4.9 Remove and replace radiator [P-2].
- 13.4.10 Inspect and test fan(s) (electrical or mechanical), fan clutch, fan shroud and air dams [P-1].
- 13.4.11 Inspect auxiliary oil coolers; determine necessary action [P-3].
- 13.4.12 Inspect, test and replace oil temperature and pressure switches and sensors [P-2].
- 13.4.13 Perform oil and filter change [P-1].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to*

*a specified level of precision. (Measurement E, 8-10)*

*Apply various measurement scales to describe phenomena and solve problems. (Measurement B, 11-12)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

### **Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society. (Science and Technology A, 9-10)*

*Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)*

*Explain how energy may change form or be redistributed but the total quantity of energy is conserved. (Physical Sciences F, 9-10).*

## **Unit 14:Automatic Transmission and Transaxle**

**Note:** Throughout Unit 14, students are expected to learn and use vocabulary specific to the automotive technician career field. Correlations to the English Language Arts **Acquisition of Vocabulary** standards include the following benchmarks:

*Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Acquisition of Vocabulary D, 11-12); and*

*Use multiple resources to enhance comprehension of vocabulary. (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12).*

### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

### **Competency 14.1: Perform general transmission and transaxle diagnosis.**

#### **Descriptors:**

- 14.1.1 Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause and correction [P-1].
- 14.1.2 Identify and interpret transmission and/or transaxle concern; assure proper engine operation; determine necessary action [P-1].
- 14.1.3 Research applicable vehicle and service information, such as transmission and/or transaxle system operation, fluid type, vehicle service history, service precautions and technical service bulletins [P-1].
- 14.1.4 Locate and interpret vehicle and major component identification numbers (i.e.,VIN, vehicle certification labels and calibration decals) [P-1].
- 14.1.5 Diagnose fluid loss and condition concerns; check fluid level on transmissions with and without dipstick; determine necessary action [P-1].
- 14.1.6 Perform pressure tests; determine necessary action [P-1].
- 14.1.7 Perform stall test; determine necessary action [P-3].
- 14.1.8 Perform lock-up converter system tests; determine necessary action [P-3].
- 14.1.9 Diagnose mechanical and vacuum control system concerns; determine necessary action [P-2].
- 14.1.10 Diagnose noise and vibration concerns; determine necessary action [P-2].
- 14.1.11 Diagnose transmission and/or transaxle gear reduction/multiplication concerns using driving, driven and held member (power flow) principles [P-1].
- 14.1.12 Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law) [P-2].
- 14.1.13 Diagnose electrical or electronic concerns using principles of electricity (Ohm's Law) [P-2].
- 14.1.14 Perform scan diagnostics [P-2].

### **Correlated English Language Arts Academic Content Benchmarks**

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources. (Research C, 11-12)*

### **Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers. (Number , Number Sense and Operations E, 8-10)*

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision. (Measurement E, 8-10)*

*Apply various measurement scales to describe phenomena and solve problems. (Measurement B, 11-12)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

### **Correlated Science Academic Content Benchmarks**

*Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance. (Physical Sciences C, 9-10)*

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems. (Physical Sciences D, 11-12)*

*Explain the ways in which the processes of technological design respond to the needs of society. (Science and Technology A, 9-10)*

### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

### **Competency 14.2: Perform transmission and transaxle maintenance and adjustment.**

#### **Descriptors:**

14.2.1 Inspect, adjust or replace throttle valve (TV) linkages or cables; manual shift linkages or cables; and/or transmission range sensor; check gear select indicator (as applicable) [P-1].

14.2.2 Service transmission; perform visual inspection; replace fluids and filters [P-1].

### **Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers. (Number, Number Sense and Operations E, 8-10)*

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision. (Measurement E, 8-10)*

*Apply various measurement scales to describe phenomena and solve problems. (Measurement B, 11-12)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

### **Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.*

(Science and Technology A, 9-10)  
 Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems. (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 14.3: Perform in-vehicle transmission and transaxle repair.**

**Descriptors:**

- 14.3.1 Inspect, adjust or replace (as applicable) vacuum modulator; inspect and repair or replace lines and hoses [P-3].
- 14.3.2 Inspect, repair and replace governor assembly [P-3].
- 14.3.3 Inspect and replace external seals and gaskets [P-2].
- 14.3.4 Inspect extension housing, bushings and seals; perform necessary action [P-3].
- 14.3.5 Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS) and retainers [P-2]
- 14.3.6 Diagnose electronic transmission control systems using a scan tool; determine necessary action [P-1].
- 14.3.7 Inspect, replace and align powertrain mounts [P-2].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.*  
 (Science and Technology A, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 14.4: Perform off-vehicle transmission and transaxle repair.**

**Descriptors:**

- 14.4.1 Remove and reinstall transmission and torque converter (rear-wheel drive) [P-2].
- 14.4.2 Remove and reinstall transaxle and torque converter assembly [P-1].
- 14.4.3 Disassemble, clean and inspect transmission and/or transaxle [P-1].
- 14.4.4 Inspect, measure, clean and replace valve body, including surfaces, bores, springs, valves, sleeves, retainers, brackets, check-balls, screens, spacers and gaskets [P-2].

- 14.4.5 Inspect servo bore, piston, seals, pin, spring and retainers; determine necessary action [P-3].
- 14.4.6 Inspect accumulator bore, piston, seals, spring and retainer; determine necessary action [P-3].
- 14.4.7 Assemble transmission and/or transaxle [P-1].
- 14.4.8 Inspect, test for leaks and flush cooler, lines and fittings [P-1].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)  
*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)  
*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)  
*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)  
*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 14.5: Inspect, measure and reseal oil pump and converter.**

**Descriptors:**

- 14.5.1 Inspect converter flex plate, attaching parts, pilot, pump drive and seal areas [P-2].
- 14.5.2 Measure torque converter endplay and check for interference; check stator clutch [P-2].
- 14.5.3 Inspect, measure and reseal oil pump assembly and components [P-1].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)  
*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)  
*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)  
*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)  
*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 14.6: Inspect and measure gear train, shafts, bushings and case.**

**Descriptors:**

- 14.6.1 Measure endplay or preload; determine necessary action [P-1].
- 14.6.2 Inspect, measure and replace thrust washers and bearings [P-2].
- 14.6.3 Inspect oil delivery seal rings, ring grooves and sealing surface areas [P-2].
- 14.6.4 Inspect bushings; determine necessary action [P-2].
- 14.6.5 Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears and carrier assembly); determine necessary action [P-2].
- 14.6.6 Inspect case bores, passages, bushings, vents and mating surfaces; determine necessary action [P-2].
- 14.6.7 Inspect transaxle drive, link chains, sprockets, gears, bearings and bushings; perform necessary action [P-2].
- 14.6.8 Inspect, measure, repair, adjust or replace transaxle final drive components [P-2].
- 14.6.9 Inspect and reinstall parking pawl, shaft, spring and retainer; determine necessary action [P-3].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 14.7: Inspect and determine necessary action for friction and reaction units.**

**Descriptors:**

- 14.7.1 Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; determine necessary action [P-2].
- 14.7.2 Measure clutch pack clearance; determine necessary action [P-1].
- 14.7.3 Air test operation of clutch and servo assemblies [P-1].
- 14.7.4 Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers; determine necessary action [P-1].
- 14.7.5 Inspect bands and drums; determine necessary action [P-2].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain the movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

## Unit 15: Manual Drive Train and Axles

**Note:** Throughout Unit 15, students are expected to learn and use vocabulary specific to the automotive technician career field. Correlations to the English Language Arts **Acquisition of Vocabulary** standards include the following benchmarks:

*Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12); and

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12).

### BIL:Essential

EDU:	12	AD
	I	P

### Competency 15.1: Perform general drive train diagnosis.

#### Descriptors:

- 15.1.1 Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause and correction [P-1].
- 15.1.2 Identify and interpret drive train concern; determine necessary action [P-1].
- 15.1.3 Research applicable vehicle and service information, such as drive train system operation, fluid type, vehicle service history, service precautions and technical service bulletins [P-1].
- 15.1.4 Locate and interpret vehicle and major component identification numbers (i.e., VIN, vehicle certification labels, calibration decals) [P-1].
- 15.1.5 Diagnose fluid loss, level and condition concerns; determine necessary action [P-1].
- 15.1.6 Drain and fill manual transmission and/or transaxle and final drive unit [P-1].

### Correlated English Language Arts Academic Content Benchmarks

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

### **Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### **Correlated Science Academic Content Benchmarks**

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 15.2: Perform clutch diagnosis and repair.**

**Descriptors:**

- 15.2.1 Diagnose clutch noise, binding, slippage, pulsation and chatter; determine necessary action [P-1].
- 15.2.2 Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots and springs; perform necessary action [P-1].
- 15.2.3 Inspect hydraulic clutch slave and master cylinders, lines, and hoses; determine necessary action [P-1].
- 15.2.4 Inspect release (throw-out) bearing, lever and pivot; determine necessary action [P-1]
- 15.2.5 Inspect and replace clutch pressure plate assembly and clutch disc [P-1].
- 15.2.6 Bleed clutch hydraulic system [P-1].
- 15.2.7 Inspect, remove or replace pilot bearing or bushing (as applicable) [P-1].
- 15.2.8 Inspect flywheel and ring gear for wear and cracks, determine necessary action [P-1].
- 15.2.9 Inspect engine block, clutch (bell) housing, transmission and transaxle case mating surfaces, and alignment dowels; determine necessary action [P-3].
- 15.2.10 Measure flywheel runout and crankshaft endplay; determine necessary action [P-2].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain the movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 15.3: Perform transmission and/or transaxle diagnosis and repair.**

**Descriptors:**

- 15.3.1 Remove and reinstall transmission and/or transaxle [P-1].

- 15.3.2 Disassemble, clean and reassemble transmission and/or transaxle components [P-1].
- 15.3.3 Inspect transmission and/or transaxle case, extension housing, case mating surfaces, bores, bushings, and vents; perform necessary action [P-3].
- 15.3.4 Diagnose noise, hard shifting, jumping out of gear and fluid leakage concerns; determine necessary action [P-2].
- 15.3.5 Inspect, adjust and reinstall shift linkages, brackets, bushings, cables, pivots and levers [P-2].
- 15.3.6 Inspect and reinstall power train mounts [P-2].
- 15.3.7 Inspect and replace gaskets, seals and sealants; inspect sealing surfaces [P-2].
- 15.3.8 Remove and replace transaxle final drive [P-3].
- 15.3.9 Inspect, adjust and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks and springs [P-2].
- 15.3.10 Measure endplay or preload (shim or spacer selection procedure) on transmission and/or transaxle shafts; perform necessary action [P-1].
- 15.3.11 Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs and blocking rings [P-1].
- 15.3.12 Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensor (VSS) and retainers [P-2].
- 15.3.13 Diagnose transaxle final drive assembly noise and vibration concerns; determine necessary action [P-3].
- 15.3.14 Remove, inspect, measure, adjust and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers and case assembly [P-2].
- 15.3.15 Inspect lubrication devices (oil pump or slinger); perform necessary action [P-3].
- 15.3.16 Inspect, test and replace transmission and/or transaxle sensors and switches [P-1].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 15.4:Perform drive shaft and half shaft, universal and constant-velocity (CV) joint diagnosis and repair.**

**Descriptors:**

- 15.4.1 Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary

- 15.4.2 Diagnose universal joint noise and vibration concerns; perform necessary action [P-1].
- 15.4.3 Remove and replace front wheel drive (FWD) front wheel bearings [P-1].
- 15.4.4 Inspect, service and replace shafts, yokes, boots and CV joints [P-1].
- 15.4.5 Inspect, service and replace shaft center support bearings [P-3].
- 15.4.6 Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles [P-2]

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 15.5: Evaluate ring and pinion gears and differential case assembly.**

**Descriptors:**

- 15.5.1 Diagnose noise and vibration concerns; determine necessary action [P-2].
- 15.5.2 Diagnose fluid leakage concerns; determine necessary action [P-1].
- 15.5.3 Inspect and replace companion flange and pinion seal; measure companion flange runout [P-2].
- 15.5.4 Insect ring gear and measure runout; determine necessary action [P-2].
- 15.5.5 Remove, inspect and reinstall drive pinion and ring gear, spacers, sleeves and bearings [P-2].
- 15.5.6 Measure and adjust drive pinion depth [P-2].
- 15.5.7 Measure and adjust drive pinion bearing preload [P-2].
- 15.5.8 Measure and adjust side bearing preload, ring and pinion gear total backlash, and backlash variation on a differential carrier assembly (threaded cup or shim types) [P-2].
- 15.5.9 Check ring and pinion tooth contact patterns; perform necessary action [P-2].
- 15.5.10 Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers and case [P-2].
- 15.5.11 Reassemble and reinstall differential case assembly; measure runout; determine necessary action [P-2].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Use formulas to find surface area and volume for specified three-dimensional objects accurate to a specified level of precision.* (Measurement B, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

#### BIL:Essential

EDU:	12	AD
	I	P

### Competency 15.6: Diagnose limited slip differential.

#### Descriptors:

15.6.1 Diagnose noise, slippage and chatter concerns; determine necessary action [P-3].

15.6.2 Clean and inspect differential housing; refill with correct lubricant [P-2].

15.6.3 Inspect and reinstall clutch (cone or plate) components [P-3].

15.6.4 Measure rotating torque; determine necessary action [P-3].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 15.7: Inspect drive axle shaft.**

**Descriptors:**

- 15.7.1 Diagnose drive axle shafts, bearings and seals for noise, vibration and fluid leakage concerns; determine necessary action [P-2].
- 15.7.2 Inspect and replace drive axle shaft wheel studs [P-1].
- 15.7.3 Remove and replace drive axle shafts [P-1].
- 15.7.4 Inspect and replace drive axle shaft seals, bearings and retainers [P-2].
- 15.7.5 Measure drive axle flange runout and shaft endplay; determine necessary action [P-2].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 15.8: Perform four-wheel drive and all-wheel drive component diagnosis and repair.**

**Descriptors:**

- 15.8.1 Diagnose noise, vibration and unusual steering concerns; determine necessary action [P-3].
- 15.8.2 Inspect, adjust and repair shifting controls (mechanical, electrical and vacuum), bushings, mounts, levers and brackets [P-3].
- 15.8.3 Remove and reinstall transfer case [P-3].
- 15.8.4 Disassemble, service and reassemble transfer case and components [P-3].
- 15.8.5 Inspect front-wheel bearings and locking hubs; perform necessary action [P-3].
- 15.8.6 Check drive assembly seals and vents; check lube level [P-3].
- 15.8.7 Diagnose, test, adjust and replace electrical and electronic components of four-wheel

drive systems [P-3].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

## Unit 16: Suspension and Steering

**Note:** Throughout Unit 16, students are expected to learn and use vocabulary specific to the automotive technician career field. Correlations to the English Language Arts **Acquisition of Vocabulary** standards include the following benchmarks:

*Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12); and

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12).

### BIL: Essential

EDU:	12	AD
	I	P

### Competency 16.1: Perform general suspension and steering systems diagnosis.

#### Descriptors:

- 16.1.1 Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause and correction [P-1].
- 16.1.2 Identify and interpret suspension and steering concern; determine necessary action [P-1].
- 16.1.3 Research applicable vehicle and service information, such as suspension and steering system operation, vehicle service history, service precautions and technical service bulletins [P-1].
- 16.1.4 Locate and interpret vehicle and major component identification numbers (i.e., VIN, vehicle certification labels, calibration decals) [P-1].

### Correlated English Language Arts Academic Content Benchmarks

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.*

(Science and Technology A, 9-10)

*Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.* (Physical Sciences G, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 16.2: Perform steering systems diagnosis and repair.**

**Descriptors:**

- 16.2.1 Disable and enable supplemental restraint system (SRS) [P-1].
- 16.2.2 Remove and replace steering wheel; center and time supplemental restraint system (SRS) coil (clock spring) [P-1].
- 16.2.3 Diagnose steering column noises, looseness and binding concerns, including tilt mechanisms; determine necessary action [P-2].
- 16.2.4 Diagnose power steering gear binding (non-rack and pinion), uneven turning effort, looseness, hard steering, noise and fluid leakage concerns; determine necessary action [P-3].
- 16.2.5 Diagnose power steering gear binding (rack and pinion), uneven turning effort, looseness, hard steering, noise and fluid leakage concerns; determine necessary action [P-3].
- 16.2.6 Inspect steering shaft universal joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism and steering wheel; perform necessary action [P-2].
- 16.2.7 Adjust manual or power non-rack and pinion worm bearing preload and sector lash [P-3].
- 16.2.8 Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets [P-1].
- 16.2.9 Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellow boots [P-1].
- 16.2.10 Determine proper power steering fluid type; inspect fluid level and condition [P-1].
- 16.2.11 Flush, fill and bleed power steering system [P-2].
- 16.2.12 Diagnose power steering fluid leakage; determine necessary action [P-2].

- 16.2.13 Remove, inspect, replace and adjust power steering pump belt [P-1].
- 16.2.14 Remove and reinstall power steering pump [P-3].
- 16.2.15 Remove and reinstall power steering pump pulley; check pulley and belt alignment [P-3].
- 16.2.16 Inspect and replace power steering hoses and fittings [P-2].
- 16.2.17 Inspect and replace pitman arm, relay rod (centerlink-intermediate), idler arm and mountings, and steering linkage damper [P-2].
- 16.2.18 Inspect, replace and adjust tie rod ends (sockets), tie rod sleeves, and clamps [P-1].
- 16.2.19 Test and diagnose components of electronically controlled steering systems using a scan tool; determine necessary action [P-3].
- 16.2.20 Inspect and test non-hydraulic electric power assist steering [P-3].
- 16.2.21 Identify hybrid vehicle power steering system electrical circuits, service and safety precautions [P-3].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 16.3: Remove, inspect and install front suspension.**

**Descriptors:**

- 16.3.1 Diagnose short and long arm suspension system noises, body sway and uneven riding height concerns; determine necessary action [P-1].
- 16.3.2 Diagnose strut suspension system noises, body sway and uneven riding height concerns; determine necessary action [P-1].
- 16.3.3 Remove, inspect and install upper and lower control arms, bushings, shafts and rebound bumpers [P-3].
- 16.3.4 Remove, inspect and install strut rods (compression and/or tension) and bushings [P-2].
- 16.3.5 Remove, inspect and install upper and/or lower ball joints [P-1].
- 16.3.6 Remove, inspect and install steering knuckle assemblies [P-2].
- 16.3.7 Remove, inspect and install short and long arm suspension system coil springs and spring insulators [P-3].
- 16.3.8 Remove, inspect, install and adjust suspension system torsion bars; inspect mounts [P-3].
- 16.3.9 Remove, inspect and install stabilizer bar bushings, brackets and links [P-2].

- 16.3.10 Remove, inspect and install strut cartridge or assembly, strut coil spring, insulators (silencers) and upper strut bearing mount [P-1].
- 16.3.11 Lubricate suspension and steering systems [P-2].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)  
*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)  
*Solve increasingly complex non-routine measurement problems and check for reasonableness of results.* (Measurement A, 8-10)  
*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)  
*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)  
*Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.* (Geometry and Spatial Sense C, 8-10)  
*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)  
*Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.* (Physical Sciences G, 9-10)  
*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 16.4: Remove, inspect and install rear suspension.**

**Descriptors:**

- 16.4.1 Remove, inspect and install coil springs and spring insulators [P-2].
- 16.4.2 Remove, inspect and install transverse links, control arms, bushings and mounts [P-2].
- 16.4.3 Remove, inspect and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings and mounts [P-3].
- 16.4.4 Remove, inspect and install strut cartridge or assembly, strut coil spring and insulators (silencers) [P-2].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)  
*Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.*

(Science and Technology A, 9-10)

*Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.* (Physical Sciences G, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 16.5: Perform miscellaneous service.**

**Descriptors:**

16.5.1 Inspect, remove and replace shock absorbers [P-1].

16.5.2 Remove, inspect and service or replace front and rear wheel bearings [P-2].

16.5.3 Test and diagnose components of electronically controlled suspension systems using a scan tool; determine necessary action [P-3].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.* (Physical Sciences G, 9-10)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 16.6: Perform wheel alignment diagnosis, adjustment and repair.**

**Descriptors:**

16.6.1 Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer and steering return concerns; determine necessary action [P-1].

16.6.2 Perform prealignment inspection; perform necessary action [P-1].

16.6.3 Measure vehicle riding height; determine necessary action [P-1].

16.6.4 Check and adjust front and rear wheel camber; perform necessary action [P-1].

16.6.5 Check and adjust caster; perform necessary action [P-1].

- 16.6.6 Check and adjust front wheel toe and center steering wheel [P-1].
- 16.6.7 Check tow-out-on-turns (turning radius); determine necessary action [P-2].
- 16.6.8 Check steering axis inclination (SAI) and included angle; determine necessary action [P-2].
- 16.6.9 Check and adjust rear wheel toe [P-1].
- 16.6.10 Check rear wheel thrust angle; determine necessary action [P-1].
- 16.6.11 Check for front wheel setback; determine necessary action [P-2].
- 16.6.12 Check front cradle (subframe) alignment; determine necessary action [P-3]

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)
- Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.* (Geometry and Spatial Sense C, 8-10)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 16.7: Perform wheel and tire diagnosis and repair.**

**Descriptors:**

- 16.7.1 Diagnose tire wear patterns; determine necessary action [P-1].
- 16.7.2 Inspect tires; check and adjust air pressure [P-1].
- 16.7.3 Diagnose wheel or tire vibration, shimmy and noise; determine necessary action [P-2].
- 16.7.4 Rotate tires according to manufacturer’s recommendations [P-1].
- 16.7.5 Measure wheel, tire, axle and hub runout; determine necessary action [P-2].
- 16.7.6 Diagnose tire pull (lead) problem; determine necessary action [P-2].
- 16.7.7 Balance wheel and tire assembly (static and dynamic) [P-1].
- 16.7.8 Dismount, inspect and remount tire on wheel [P-2].
- 16.7.9 Dismount, inspect and remount tire on a wheel equipped with a tire pressure sensor [P-3].
- 16.7.10 Reinstall wheel; torque lug nuts [P-1].
- 16.7.11 Inspect tire and wheel assembly for air loss; perform necessary action [P-1].
- 16.7.12 Repair a tire using an internal patch [P-1].
- 16.7.13 Inspect, diagnose and calibrate tire pressure monitoring system [P1].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.* (Geometry and Spatial Sense C, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

## Unit 17: Brakes

**Note:** Throughout Unit 17, students are expected to learn and use vocabulary specific to the automotive technician career field. Correlations to the English Language Arts **Acquisition of Vocabulary Standard** include the following benchmarks:

*Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

### BIL: Essential

EDU:	12	AD
	I	P

### Competency 17.1: Perform general brake systems diagnosis.

#### Descriptors:

- 17.1.1 Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause and correction [P-1].
- 17.1.2 Identify and interpret brake system concern; determine necessary action [P-1].
- 17.1.3 Research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions and technical service bulletins [P-1].
- 17.1.4 Locate and interpret vehicle and major component identification numbers (i.e., VIN, vehicle certification labels, calibration decals) [P-1].

### Correlated English Language Arts Academic Content Benchmarks

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

### **Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### **Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain the movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

#### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

### **Competency 17.2: Perform hydraulic system diagnosis and repair.**

#### **Descriptors:**

- 17.2.1 Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law) [P-1].
- 17.2.2 Measure brake pedal height; determine necessary action [P-2].
- 17.2.3 Check master cylinder for internal and external leaks and proper operation; determine necessary action [P-2].
- 17.2.4 Remove, bench bleed and reinstall master cylinder [P-1].
- 17.2.5 Diagnose poor stopping, pulling or dragging concerns caused by malfunctions in the hydraulic system; determine necessary action [P-1].
- 17.2.6 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-2].
- 17.2.7 Fabricate and/or install brake lines (double flare and ISO types); replace hoses, fittings and supports as needed [P-2].
- 17.2.8 Select, handle, store and fill brake fluids to the proper level [P-1].
- 17.2.9 Inspect, test, and/or replace metering (hold-off), proportioning (balance), pressure differential and combination valves [P-2].
- 17.2.10 Inspect, test and adjust height (load) sensing proportioning valve [P-3].
- 17.2.11 Inspect, test and/or replace components of a brake warning light system [P-3].
- 17.2.12 Bleed (manual, pressure, vacuum or surge) a brake system [P-1].
- 17.2.13 Flush a hydraulic system [P-3].

### **Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### **Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain the movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

### **Competency 17.3: Perform drum brake diagnosis and repair.**

#### **Descriptors**

17.3.1 Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action [P-1].

17.3.2 Remove, clean (using proper safety procedures), inspect and measure brake drums; determine necessary action [P-1].

17.3.3 Refinish a brake drum [P-1].

17.3.4 Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters (including self-adjusters), other related brake hardware and backing support plates; lubricate and reassemble [P-1].

17.3.5 Remove, inspect and install wheel cylinders [P-2].

17.3.6 Pre-adjust brake shoes and parking brake before installing brake drums or drum and hub assemblies and wheel bearings [P-1].

17.3.7 Install wheel, torque lug nuts and make final checks and adjustments [P-1].

### **Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### **Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

10) *Explain the movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 17.4: Perform disc brake diagnosis and repair**

**Descriptors:**

- 17.4.1 Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action [P-1].
- 17.4.2 Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action [P-1].
- 17.4.3 Clean and inspect caliper mounting and slides for wear and damage; determine necessary action [P-1].
- 17.4.4 Remove, clean and inspect pads and retaining hardware; determine necessary action [P-1].
- 17.4.5 Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring and damage; replace seal, boot and damaged or worn parts [P-2].
- 17.4.6 Reassemble, lubricate and reinstall caliper, pads and related hardware; seat the pads, and inspect for leaks [P-1].
- 17.4.7 Clean, inspect and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining whether to machine or replace [P-1].
- 17.4.8 Remove and reinstall rotor [P-1].
- 17.4.9 Refinish rotor on the vehicle [P-1].
- 17.4.10 Refinish rotor off the vehicle [P-1].
- 17.4.11 Adjust calipers equipped with an integrated parking brake system [P-3].
- 17.4.12 Install wheel, torque lug nuts and make final checks and adjustments [P-1].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain the movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 17.5: Perform power assist unit diagnosis and repair.**

**Descriptors:**

- 17.5.1 Test pedal free travel with and without the engine running; check power assist operation [P-2].
- 17.5.2 Check the vacuum supply (manifold or auxiliary pump) to a vacuum-type power booster [P-2].
- 17.5.3 Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action [P-2].
- 17.5.4 Inspect and test a hydraulically assisted power brake system for leaks and proper operation; determine necessary action [P-3].
- 17.5.5 Measure and adjust master cylinder pushrod length [P-3].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- Explain the movement of objects by applying Newton’s three laws of motion.* (Physical Sciences D, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 17.6: Perform miscellaneous diagnosis and repair, including wheel bearings, parking brakes and electrical.**

**Descriptors:**

- 17.6.1 Diagnose wheel bearing noises, wheel shimmy and vibration concerns; determine necessary action [P-1].
- 17.6.2 Remove, clean, inspect, repack and install wheel bearings and replace seals; install hub and adjust wheel bearings [P-1].
- 17.6.3 Check parking brake cables and components for wear, rusting, binding and corrosion; clean, lubricate or replace as needed [P-2].
- 17.6.4 Check parking brake operation; determine necessary action [P-1].
- 17.6.5 Check the operation of parking brake indicator light system [P-3].
- 17.6.6 Check the operation of brake stop light system; determine necessary action [P-1].
- 17.6.7 Replace wheel bearing and race [P-1].
- 17.6.8 Inspect and replace wheel studs [P-1].
- 17.6.9 Remove and reinstall sealed wheel bearing assembly [P-2].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain the movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

#### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

### Competency 17.7: Diagnose antilock brake and traction control systems.

#### **Descriptors:**

- 17.7.1 Identify and inspect antilock brake system (ABS) components; determine necessary action [P-1].
- 17.7.2 Diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise concerns caused by the ABS; determine necessary action [P-2].
- 17.7.3 Diagnose ABS electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action [P-1].
- 17.7.4 Depressurize high-pressure components of the ABS [P-3].
- 17.7.5 Bleed the ABS's front and rear hydraulic circuits [P-2].
- 17.7.6 Remove and install ABS electrical and/or electronic and hydraulic components [P-3].
- 17.7.7 Test, diagnose and service ABS speed sensors, toothed ring (tone wheel) and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DOS) that includes output signal, resistance, shorts to voltage/ground, and frequency data [P-1].
- 17.7.8 Diagnose ABS braking concerns caused by vehicle modifications (e.g., tire size, curb height, final drive ratio) [P-3].
- 17.7.9 Identify traction control and/or vehicle stability control system components [P-3].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

## Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain the movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

## Unit 18:Electrical and Electronic Systems

**Note:** Throughout Unit 18, students are expected to learn and use vocabulary specific to the automotive technician career field. Correlations to the English Language Arts **Acquisition of Vocabulary** standards include the following benchmarks:

*Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12); and

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12).

### BIL:Essential

EDU:	12	AD
	I	P

### Competency 18.1: Perform general electrical system diagnosis.

#### Descriptors:

- 18.1.1 Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause and correction [P-1].
- 18.1.2 Identify and interpret electrical and electronic system concern; determine necessary action [P-1].
- 18.1.3 Research applicable vehicle and service information, such as electrical and electronic system operation, vehicle service history, service precautions and technical service bulletins [P-1].
- 18.1.4 Locate and interpret vehicle and major component identification numbers (i.e., VIN, vehicle certification labels, and calibration decals) [P-1].
- 18.1.5 Diagnose the electrical and electronic integrity of series, parallel and series-parallel circuits using principles of electricity (e.g., Ohm's Law, WATTS Law) [P-1].
- 18.1.6 Use wiring diagrams during diagnosis of electrical circuit problems [P-1].
- 18.1.7 Demonstrate the proper use of a digital multimeter (DMM) during diagnosis of electrical circuit problems [P-1].
- 18.1.8 Check electrical circuits with a test light; determine necessary action [P-2].
- 18.1.9 Measure source voltage and perform voltage drop tests in electrical and electronic circuits using a voltmeter; determine necessary action [P-1].
- 18.1.10 Measure current flow in electrical and electronic circuits and components using an ammeter; determine necessary action [P-1].
- 18.1.11 Check continuity and measure resistance in electrical and electronic circuits and components using an ohmmeter; determine necessary action [P-1].
- 18.1.12 Check electrical circuits using fused jumper wires; determine necessary action [P-2].
- 18.1.13 Locate shorts, grounds, opens and resistance problems in electrical and electronic circuits; determine necessary action [P-1].
- 18.1.14 Measure and diagnose the cause(s) of excessive key-off battery drain (parasitic draw);

- determine necessary action [P-1].
- 18.1.15 Inspect and test fusible links, circuit breakers, and fuses; determine necessary action [P-1].
- 18.1.16 Inspect and test switches, connectors, relays, solenoid, solid state devices and wires of electrical and electronic circuits; perform necessary action [P-1].

**Correlated English Language Arts Academic Content Benchmarks**

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.* (Scientific Inquiry A, 9-10)

**BIL:Essential**

EDU:	12	AD
	I	P

**Competency 18.2: Remove and replace terminal end from connector.**

**Descriptors:**

- 18.2.1 Repair connectors and terminals ends [P-1].
- 18.2.2 Repair wiring harness (including all communication systems) [P-1].
- 18.2.3 Perform solder repair of electrical wiring [P-1].
- 18.2.4 Identify the location of hybrid vehicle high voltage circuit disconnect (service plug) and safety procedures [P-3].

**BIL:Essential**

EDU:	12	AD
	I	P

### Competency 18.3: Perform battery diagnosis and service.

#### Descriptors:

- 18.3.1 Perform a battery state-of-charge test; determine necessary action [P-1].
- 18.3.2 Perform a battery capacity test (or conductance test); confirm proper battery capacity for vehicle application; determine necessary action [P-1].
- 18.3.3 Maintain or restore electronic memory functions [P-1].
- 18.3.4 Inspect, clean, fill and replace battery [P-1].
- 18.3.5 Perform a slow and fast battery charge [P-2].
- 18.3.6 Inspect and clean battery cables, connectors, clamps and hold-downs; repair or replace as needed [P-1].
- 18.3.7 Start a vehicle using jumper cables and a battery or auxiliary power supply using appropriate manufacturer's jumping techniques and precautions [P-1].
- 18.3.8 Identify the high voltage circuit of electric or hybrid electric vehicles and related safety precautions [P-3].
- 18.3.9 Identify electronic modules, security systems and/or radios that require reinitialization or code entry following battery disconnect [P-2].
- 18.3.10 Identify hybrid vehicle auxiliary (12v) battery service, repair and test procedures [P-3].

#### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

#### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

#### BIL:Essential

EDU:	12	AD
	I	P

### Competency 18.4: Perform starting system diagnosis and repair.

#### Descriptors:

- 18.4.1 Perform starter current draw tests; determine necessary action [P-1].
- 18.4.2 Perform starter circuit voltage drop tests; determine necessary action [P-1].
- 18.4.3 Inspect and test starter relays and solenoids; determine necessary action [P-2].
- 18.4.4 Remove and install a starter in a vehicle [P-1].
- 18.4.5 Inspect and test switches, connectors and wires of starter control circuits; perform necessary action [P-2].
- 18.4.6 Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition [P-2].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

#### **BIL: Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

### Competency 18.5: Perform charging system diagnosis and repair.

#### **Descriptors:**

18.5.1 Perform charging system output tests; determine necessary action [P-1].

18.5.2 Diagnose charging system for the cause of undercharge, no-charge and overcharge conditions [P-1].

18.5.3 Inspect, adjust or replace generator (alternator) drive belts, pulleys and tensioners; check pulley and belt alignment [P-1].

18.5.4 Remove, inspect and install generator (alternator) [P-1].

18.5.5 Perform charging circuit voltage drop tests; determine necessary action [P-1].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

#### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 18.6: Perform lighting systems diagnosis and repair.**

**Descriptors:**

- 18.6.1 Diagnose the cause of brighter than normal, intermittent, dim or no light operation; determine necessary action [P-1].
- 18.6.2 Inspect, replace and aim headlights and bulbs [P-2].
- 18.6.3 Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action [P-2].
- 18.6.4 Identify system voltage and safety precautions associated with high intensity discharge headlights [P-3].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 18.7: Perform gauges, warning devices and driver information systems diagnosis and repair.**

**Descriptors:**

- 18.7.1 Inspect and test gauges and gauge sending units for cause of intermittent, high, low or no gauge readings; determine necessary action [P-1].
- 18.7.2 Inspect and test connectors, wires and printed circuit boards of gauge circuits; determine necessary action [P-3].
- 18.7.3 Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action [P-1].
- 18.7.4 Inspect and test sensors, connectors and wires of electronic (digital) instrument circuits; determine necessary action [P-3].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

12) *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### **Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

#### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

### **Competency 18.8: Perform horn and windshield wiper/washer diagnosis and repair.**

#### **Descriptors:**

18.8.1 Diagnose incorrect horn operation; perform necessary action [P-2].

18.8.2 Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action [P-2].

18.8.3 Diagnose incorrect washer operation; perform necessary action [P-2].

### **Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

12) *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

### **Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

#### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

### **Competency 18.9: Perform accessories diagnosis and repair.**

#### **Descriptors:**

18.9.1 Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action [P-2].

18.9.2 Diagnose incorrect heated glass, mirror or seat operation; determine necessary action [P-2].

- 18.9.3 Diagnose incorrect electric lock operation; determine necessary action [P-2].
- 18.9.4 Diagnose incorrect operation of cruise control systems; determine necessary action [P-3].
- 18.9.5 Diagnose supplemental restraint system (SRS) concerns; determine necessary action (Note: Follow manufacturer’s safety procedures to prevent accidental deployment) [P-1].
- 18.9.6 Disarm and enable the airbag system for vehicle service [P-1].
- 18.9.7 Diagnose radio static and weak, intermittent or no radio reception; determine necessary action [P-3].
- 18.9.8 Remove and reinstall door panel [P-1].
- 18.9.9 Diagnose body electronic system circuits using a scan tool; determine necessary action [P-2].
- 18.9.10 Check for module communication errors, including Controller Area Network (CAN) or BUS systems, using a scan tool [P-3].
- 18.9.11 Diagnose the cause of false, intermittent or no operation of anti-theft systems [P-2].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

**Unit 19: Heating and Air Conditioning (A/C)**

**Note:** Throughout Unit 19, students are expected to learn and use vocabulary specific to the automotive technician career field. Correlations to the English Language Arts **Acquisition of Vocabulary** standards include the following benchmarks:

- Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12); and
- Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12).

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 19.1: Perform A/C system diagnosis and repair.**

**Descriptors:**

- 19.1.1 Identify refrigerant type, select and connect proper gauge set; record pressure readings [P-1].
- 19.1.2 Complete work order to include customer information, vehicle identifying information,

- 19.1.3 customer concern, related service history, cause and correction [P-1]. Identify and interpret heating and air conditioning concern; determine necessary action [P-1].
- 19.1.4 Research applicable vehicle and service information, such as heating and air conditioning system operation, vehicle service history, service precautions, and technical service bulletins [P-1].
- 19.1.5 Locate and interpret vehicle and major component identification numbers (i.e., VIN, vehicle certification labels, calibration decals) [P-1].
- 19.1.6 Performance test A/C system; diagnose A/C system malfunctions using principles of refrigeration [P-1].
- 19.1.7 Diagnose abnormal operation noises in the A/C system; determine necessary action [P-2].
- 19.1.8 Leak test A/C system; determine necessary action [P-1].
- 19.1.9 Inspect the condition of discharged oil; determine necessary action [P-2].
- 19.1.10 Determine recommended oil for system application [P-1].
- 19.1.11 Using scan tool, observe and record related heating, ventilation and air conditioning (HVAC) data and trouble codes [P-1].

**Correlated English Language Arts Academic Content Benchmarks**

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 19.2:Perform refrigeration system component diagnosis and repair, including compressor and clutch.**

**Descriptors:**

- 19.2.1 Diagnose A/C system conditions that cause the protection devices (pressure, thermal and

- power train control module [PCM]) to interrupt system operation; determine necessary action [P-2].
- 19.2.2 Inspect and replace A/C compressor drive belts; determine necessary action [P-1].
- 19.2.3 Inspect, test and/or replace A/C compressor clutch components and/or assembly [P-2].
- 19.2.4 Remove, inspect and reinstall A/C compressor and mountings; determine required oil quantity [P-1].
- 19.2.5 Identify hybrid vehicle A/C system electrical circuits, service and safety precautions [P-3].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 19.3: Remove and inspect evaporator, condenser and related components.**

**Descriptors:**

- 19.3.1 Determine need for an additional A/C system filter; perform necessary action [P-3].
- 19.3.2 Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals and service valves; perform necessary action [P-2].
- 19.3.3 Inspect A/C condenser for airflow restrictions; perform necessary action [P-1].
- 19.3.4 Remove, inspect and reinstall receiver/drier or accumulator/drier; determine required oil quantity [P-1].
- 19.3.5 Remove and install expansion valve or orifice (expansion) tube [P-1].
- 19.3.6 Inspect evaporator housing water drain; perform necessary action [P-3].
- 19.3.7 Remove, inspect and reinstall evaporator; determine required oil quantity [P-3].
- 19.3.8 Remove, inspect and reinstall condenser; determine required oil quantity [P-3].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 19.4: Perform heating, ventilation and engine cooling systems diagnosis and repair.**

**Descriptors:**

- 19.4.1 Diagnose temperature control problems in the heating and ventilation system; determine necessary action [P-2].
- 19.4.2 Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank and hoses; perform necessary action [P-1].
- 19.4.3 Inspect engine heating and cooling system hoses and belts; perform necessary action [P-1].
- 19.4.4 Inspect, test and replace thermostat and gasket [P-1].
- 19.4.5 Determine coolant condition and coolant type for vehicle application; drain and recover coolant [P-1].
- 19.4.6 Flush system; refill system with recommended coolant; bleed system [P-1].
- 19.4.7 Inspect and test cooling fan, fan clutch, fan shroud and air dams; perform necessary action [P-1].
- 19.4.8 Inspect and test electric cooling fan, fan control system and circuits; determine necessary action [P-1].
- 19.4.9 Inspect and test heater control valve(s); perform necessary action [P-2].
- 19.4.10 Remove, inspect and reinstall heater core [P-3].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 19.5: Perform diagnosis and repair of operation systems and related controls.**

**Descriptors:**

- 19.5.1 Diagnose malfunctions in the electrical controls of the heating, ventilation and air conditioning (HVAC) systems; determine necessary action [P-2].
- 19.5.2 Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring and protection devices; perform necessary action [P-1].
- 19.5.3 Test and diagnose A/C compressor clutch control systems; determine necessary action [P-1].
- 19.5.4 Diagnose malfunctions in the vacuum, mechanical and electrical components and controls of the HVAC system; determine necessary action [P-2].
- 19.5.5 Inspect and test A/C-heater control panel assembly; determine necessary action [P-3].
- 19.5.6 Inspect and test A/C-heater control cables, motors and linkages; perform necessary action [P-3].
- 19.5.7 Inspect A/C-heater ducts, doors, hoses, cabin filters and outlets; perform necessary action [P-3].
- 19.5.8 Check operation of automatic and semi-automatic HVAC control systems; determine necessary action [P-3].

**Correlated Mathematics Academic Content Benchmarks**

- Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 19.6: Perform refrigerant recovery, recycling and handling.**

**Descriptors:**

- 19.6.1 Perform correct use and maintenance of refrigerant handling equipment [P-1].
- 19.6.2 Identify (by label application or use of a refrigerant identifier) and recover A/C system refrigerant [P-1].
- 19.6.3 Recycle refrigerant [P-1].
- 19.6.4 Label and store refrigerant [P-1].
- 19.6.5 Test recycled refrigerant for non-condensable gases [P-1].
- 19.6.6 Evacuate and charge A/C system [P-1].
- 19.6.7 Acquire refrigerant handling certificate [P-1].

**Correlated English Language Arts Academic Content Benchmarks**

*Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)*

### **Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers. (Number, Number Sense and Operations E, 8-10)*

*Apply various measurement scales to describe phenomena and solve problems. (Measurement B, 11-12)*

*Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*

### **Correlated Science Academic Content Benchmarks**

*Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future. (Earth and Space Sciences C, 11-12)*

## **Unit 20:Engine Performance**

**Note:** Throughout Unit 20, students are expected to learn and use vocabulary specific to the automotive technician career field. Correlations to the English Language Arts **Acquisition of Vocabulary** standards include the following benchmarks:

*Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Acquisition of Vocabulary D, 11-12); and*

*Use multiple resources to enhance comprehension of vocabulary. (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12).*

### **BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

### **Competency 20.1: Perform general engine diagnosis.**

#### **Descriptors:**

- 20.1.1 Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause and correction [P-1].
- 20.1.2 Identify and interpret engine performance concern; determine necessary action [P-1].
- 20.1.3 Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions and technical service bulletins [P-2].
- 20.1.4 Locate and interpret vehicle and major component identification numbers (i.e., VIN, vehicle certification labels, and calibration decals) [P-1].
- 20.1.5 Inspect engine assembly for fuel, oil, coolant and other leaks; determine necessary action [P-2].
- 20.1.6 Diagnose abnormal engine noise or vibration concerns; determine necessary action [P-2].
- 20.1.7 Diagnose abnormal exhaust color, odor and sound; determine necessary action [P-2].
- 20.1.8 Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action [P-1].
- 20.1.9 Perform cylinder power balance test; determine necessary action [P-1].
- 20.1.10 Perform cylinder cranking compression tests; determine necessary action [P-1].
- 20.1.11 Perform engine running compression test; determine necessary action [P-2].

- 20.1.12 Perform cylinder leakage test; determine necessary action [P-1].
- 20.1.13 Diagnose engine mechanical, electrical, electronic fuel and ignition concerns with an oscilloscope and/or engine diagnostic equipment; determine necessary action [P-1].
- 20.1.14 Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test; obtain exhaust readings; interpret readings; determine necessary action [P-1].
- 20.1.15 Verify engine operating temperature; determine necessary action [P-1].
- 20.1.16 Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank and hoses; perform necessary action [P-1].
- 20.1.17 Verify correct camshaft timing [P-2].

**Correlated English Language Arts Academic Content Benchmarks**

*Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

*Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

*Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

*Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 20.2: Perform diagnosis and repair of computerized engine controls.**

**Descriptors:**

- 20.2.1 Retrieve and record stored on-board diagnostics (OBD) I diagnostic trouble codes; clear codes [P-3].
- 20.2.2 Retrieve and record stored OBD II diagnostic trouble codes; clear codes when applicable [P-1].
- 20.2.3 Diagnose the causes of emissions or drivability concerns resulting from malfunctions in the computerized engine control system with stored diagnostic trouble codes [P-1].

- 20.2.4 Diagnose emissions or drivability concerns resulting from malfunctions in the computerized engine control system with no stored diagnostic trouble codes; determine necessary action [P-1].
- 20.2.5 Check for module communication errors, including controller area network (CAN) and BUS systems, using a scan tool [P-2].
- 20.2.6 Inspect and test computerized engine control system sensors, power train control module (PCM), actuators and circuits using a graphing multimeter (GMM) and digital storage oscilloscope (DSO); perform necessary action [P-1].
- 20.2.7 Obtain and interpret scan tool data [P-1].
- 20.2.8 Access and use service information to perform step-by-step diagnosis [P-1].
- 20.2.9 Diagnose drivability and emissions problems resulting from malfunctions of interrelated systems, including cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-original equipment manufacturer (OEM)-installed accessories or similar systems; determine necessary action [P-3].
- 20.2.10 Perform active tests of actuators using scan tool; determine necessary action [P-1].

**Correlated Mathematics Academic Content Benchmarks**

- Apply various measurement scales to describe phenomena and solve problems. (Measurement B, 11-12)*
- Identify and classify functions as linear or nonlinear, and contrast their properties using tables, graphs or equations. (Patterns, Functions and Algebra B, 8-10)*
- Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis and Probability F, 8-10)*
- Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)*

**Correlated Science Academic Content Benchmarks**

- Explain the ways in which the processes of technological design respond to the needs of society. (Science and Technology A, 9-10)*
- Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems. (Physical Sciences D, 11-12)*

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 20.3: Perform ignition system diagnosis and repair.**

**Descriptors:**

- 20.3.1 Diagnose ignition system-related problems such as no starting, hard starting, engine misfire, poor drivability, spark knock, power loss, poor mileage and emissions concerns on vehicles with electronic ignition (distributorless) systems; determine necessary action [P-1].
- 20.3.2 Diagnose ignition system-related problems such as no starting, hard starting, engine misfire, poor drivability, spark knock, power loss, poor mileage and emissions concerns on vehicles with distributor ignition (DI) systems; determine necessary action [P-1].
- 20.3.3 Inspect and test ignition primary circuit wiring and solid state components; perform necessary action [P-2].
- 20.3.4 Inspect, test and service distributor [P-3].

- 20.3.5 Inspect and test ignition system secondary circuit wiring and components; perform necessary action [P-2].
- 20.3.6 Inspect and test ignition coil(s); perform necessary action [P-1].
- 20.3.7 Check and adjust ignition system timing and timing advance/retard, where applicable [P-3].
- 20.3.8 Inspect and test ignition system pick-up sensor or triggering devices; perform necessary action [P-1].

**Correlated Mathematics Academic Content Benchmarks**

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

*Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 20.4: Perform fuel, air induction and exhaust systems diagnosis and repair.**

**Descriptors:**

- 20.4.1 Diagnose hot or cold no-starting, hard starting, poor drivability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling and emissions problems on vehicles with injection-type fuel systems; determine necessary actions [P-1].
- 20.4.2 Check fuel for contaminants and quality; determine necessary action [P-3].
- 20.4.3 Inspect and test fuel pumps and pump control systems for pressure, regulation and volume; perform necessary action [P-1].
- 20.4.4 Replace fuel filters [P-1].
- 20.4.5 Inspect and test cold enrichment system and components; perform necessary action [P-3].
- 20.4.6 Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air [P-2].
- 20.4.7 Inspect and test fuel injectors [P-1].
- 20.4.8 Check idle speed [P-2].
- 20.4.9 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-2].
- 20.4.10 Perform exhaust system back-pressure test; determine necessary action [P-1].
- 20.4.11 Test the operation of turbocharger and supercharger systems; determine necessary action [P-3].

**Correlated Mathematics Academic Content Benchmarks**

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

*Apply mathematical knowledge and skills routinely in other content areas and practical situations.*  
(Mathematical Processes B, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.*  
(Science and Technology A, 9-10)

**Unit 21:Emissions Control Systems Diagnosis and Repair**

**Note:** Throughout Unit 21, students are expected to learn and use vocabulary specific to the automotive technician career field. Correlations to the English Language Arts **Acquisition of Vocabulary** standards include the following benchmarks:

*Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.*  
(Acquisition of Vocabulary D, 11-12); and

*Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12).

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 21.1: Diagnose positive crankcase ventilation system.**

**Descriptors:**

- 21.1.1 Diagnose oil leaks, emissions and drivability problems resulting from malfunctions in the positive crankcase ventilation (PCV) system; determine necessary action [P-2].
- 21.1.2 Inspect, test and service PCV filter, breather cap, valve, tubes, orifices and hoses; perform necessary action [P-2].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.*  
(Science and Technology A, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	<b>I</b>	<b>P</b>

**Competency 21.2: Evaluate exhaust gas recirculation system.**

**Descriptors:**

- 21.2.1 Diagnose emissions and drivability problems caused by malfunctions in the exhaust gas recirculation (EGR) system; determine necessary action [P-1].
- 21.2.2 Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum and pressure controls, filters, and hoses; perform necessary action [P-1]
- 21.2.3 Inspect and test electrical and electronic sensors, controls and wiring of EGR systems; perform necessary action [P-2].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)  
*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)  
*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)  
*Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

**Correlated Science Academic Content Benchmarks**

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

**BIL:Essential**

<b>EDU:</b>	<b>12</b>	<b>AD</b>
	I	P

**Competency 21.3: Evaluate exhaust gas treatment system.**

**Descriptors:**

- 21.3.1 Diagnose emissions and drivability problems resulting from malfunctions in the secondary air injection and catalytic converter systems; determine necessary action [P-2].
- 21.3.2 Inspect and test mechanical components of secondary air injection systems; perform necessary action [P-3].
- 21.3.3 Inspect and test electrical and electronically-operated components and circuits of air injection systems; perform necessary action [P-3].
- 21.3.4 Inspect and test catalytic converter performance [P-1].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)  
*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)  
*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)  
*Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

### Correlated Science Academic Content Benchmarks

- *Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

#### **BIL:Essential**

EDU:	12	AD
	I	P

### Competency 21.4: Diagnose evaporative emissions controls system.

#### **Descriptors:**

- 21.4.1 Diagnose emissions and drivability problems resulting from malfunctions in the evaporative emissions control system; determine necessary action [P-1].
- 21.4.2 Inspect and test components and hoses of evaporative emissions control system; perform necessary action [P-2].
- 21.4.3 Interpret evaporative emission-related diagnostic trouble codes (DTCs); determine necessary action [P-1].

### Correlated Mathematics Academic Content Benchmarks

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

*Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

### Correlated Science Academic Content Benchmarks

*Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

#### **BIL:Essential**

EDU:	12	AD
	I	P

### Competency 21.5: Perform engine-related service.

#### **Descriptors:**

- 21.5.1 Adjust valves on engines with mechanical or hydraulic lifters [P-1].
- 21.5.2 Remove and replace timing belt; verify correct camshaft timing [P-1].
- 21.5.3 Remove and replace thermostat and gasket [P-1].
- 21.5.4 Inspect and test mechanical and electrical fans, fan clutch, fan shroud or ducting, air dams, and fan control devices; perform necessary action [P-1].
- 21.5.5 Perform common fastener and thread repairs, including removing broken bolt, restoring internal and external threads, and repairing internal threads with a thread insert [P-1].
- 21.5.6 Perform oil and filter changes [P-1].

- 21.5.7 Demonstrate proficiency in using an oxy-acetylene torch to heat and cut metal [P-3].  
21.5.8 Identify hybrid vehicle internal combustion engine service precautions [P-3].

**Correlated Mathematics Academic Content Benchmarks**

*Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

*Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

*Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)

# *Technology Standards*

## **Standard 1: Nature of Technology**

**Students develop an understanding of technology, its characteristics, scope, core concepts\* and relationships between technologies and other fields.**

Benchmark A: Synthesize information, evaluate and make decisions about technologies.

Benchmark B: Apply technological knowledge in decision-making.

Benchmark C: Examine the synergy between and among technologies and other fields of study when solving technological problems.

## **Standard 2: Technology and Society Interaction**

**Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.**

Benchmark A: Interpret and practice responsible citizenship relative to technology.

Benchmark B: Demonstrate the relationship among people, technology and the environment.

Benchmark C: Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.

Benchmark D: Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.

Benchmark E: Forecast the impact of technological products and systems.

## **Standard 3: Technology for Productivity Applications**

**Students learn the operations of technology through the usage of technology and productivity tools.**

Benchmark A: Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.

Benchmark B: Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

#### **Standard 4: Technology and Communication Applications**

**Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning.**

Benchmark A: Apply appropriate communication design principles in published and presented projects.

Benchmark B: Create, publish and present information, utilizing formats appropriate to the content and audience.

Benchmark C: Identify communication needs, select appropriate communication tools and design collaborative interactive projects and activities to communicate with others, incorporating emerging technologies.

#### **Standard 5: Technology and Information Literacy**

**Students engage in information literacy strategies, use the Internet, technology tools and resources, and apply information-management skills to answer questions and expand knowledge.**

Benchmark A: Determine and apply an evaluative process to all information sources chosen for a project.

Benchmark B: Apply a research process model to conduct research and meet information needs.

Benchmark C: Formulate advanced search strategies, demonstrating an understanding of the strengths and limitations of the Internet, and evaluate the quality and appropriate use of Internet resources.

Benchmark D: Evaluate choices of electronic resources and determine their strengths and limitations.

#### **Standard 6: Design**

**Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.**

Benchmark A: Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

Benchmark B: Recognize the role of teamwork in engineering design and of prototyping in the design process.

Benchmark C: Understand and apply research, development and experimentation to problem-solving.

## **Standard 7: Designed World**

**Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, issues and career connections.**

Benchmark A: Classify, demonstrate, examine, and appraise energy and power technologies.

Benchmark B: Classify, demonstrate, examine and appraise transportation technologies.

Benchmark C: Classify, demonstrate, examine and appraise manufacturing technologies.

Benchmark D: Classify, demonstrate, examine and appraise construction technologies.

Benchmark E: Classify, demonstrate, examine and appraise information and communication technologies

Benchmark F: Classify, demonstrate, examine and appraise medical technologies.

Benchmark G: Classify, demonstrate, examine and appraise agricultural and related biotechnologies.

# *Performance Measures/Student Assessment/Instructional Strategies*

## **Assessments/Evaluations**

- Observations
- Demonstrations
- Portfolios
- Standardized Tests
- Class Assignment
- Quizzes/Tests/Exams
- Web Exam/Certification

## **Instructional Strategies**

- Teacher-Directed & Student-Centered Activities
- Case Study Problem Solving
- Cooperative Learning
- Project-Based Learning
- Career-Based Learning (Internships/Shadowing/Placement)
- Community-Based Learning (CTSOs and Other)
- Exploratory Learning
- Independent Research
- Team Teaching

## **Content Specific Strategies**