

Transportation Systems

Career Field Technical Content Standards

with
Academic Content Standards in
English Language Arts, Mathematics and Sciences

2006



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Foreword

The *Transportation Systems Career Field Technical Content Standards* are the curricular framework for career-technical education programs in transportation. This document reflects the career field framework outlined in Ohio Administrative Code 3301-61-03 (Criteria for Secondary Workforce Development Programs).

This document represents a collaborative effort of the following professional partners: the Ohio Department of Education's Office of Career-Technical Education; the Ohio Board of Regents; the College Tech Prep Curriculum Service Center at the University of Toledo; and the Ohio Resource Center for Mathematics, Science and Reading at The Ohio State University. Secondary and postsecondary educators, along with business and industry professionals, also participated in the development of the technical content standards.

The Transportation Systems Career Field Technical Content Standards combine business and industry standards (reflecting science, mathematics, English language arts and technology), academic content standards (English language arts, mathematics and science) and the business process framework to develop technical literacy in transportation systems. The transportation system career field includes occupations that focus on aviation, mechanical and power technologies. The transportation systems career field is comprised of two pathways leading to technically-based careers in:

- Ground transportation; and
- Air transportation.

This document delineates competencies that outline the knowledge and skills needed for career success in the above two pathways. It includes a) core competencies that span the transportation career field addressing critical workplace skills including technical skills, business processes, problem solving and critical thinking, leadership, and teamwork skills; and b) pathway and specialization competencies that describe specific occupational knowledge and skills.

In addition, benchmarks from the Ohio *English Language Arts Academic Content Standards*, the *Mathematics Academic Content Standards* and the *Science Academic Content Standards* have been embedded, outlining the language arts, mathematics and science knowledge and skills associated with specific technical competencies.

This Transportation Systems document seeks to provide the basis for educational programming that will foster the development of what Doug Bush, vice president and chief information officer, Intel Corporation, refers to as the "T-shaped" employee. The T-shaped employee combines broad knowledge, insight and understanding of business processes, academic attainment, and workplace readiness (the crossbar of the "T") with depth of knowledge and expertise in a career specialty (the post of the "T"). The T-shaped employee is needed to ensure that Ohio's transportation workforce of tomorrow is competitive in a global environment that requires specialized skills in a broader context aimed at the innovation of new products and services in an ever-changing economy.

This document forms the basis for the development of an integrated delivery system that provides opportunities for new and challenging programs and courses. It is hoped that the document will enhance and expand career-technical education and postsecondary degree programs in transportation and related fields.

The document is available on the Internet at www.techprepohio.com.

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ACKNOWLEDGEMENTS

A number of individuals contributed their time and expertise to this development. Special thanks go to all the business representatives and educators named in this document.

Further acknowledgement is due to:

- David Burns, Executive Director, Secondary Education and Workforce Development, Ohio Department of Education;
- Jonathan Tafel, Vice Chancellor for Educational Linkages and Access, Ohio Board of Regents;
- Kathy Shibley, Director, Office of Career-Technical and Adult Education, Ohio Department of Education;
- Kathy Sommers, Assistant Director, Office of Career-Technical and Adult Education, Ohio Department of Education;
- Anthony Landis, Assistant Director, College Tech Prep and Carl D. Perkins Programs, Ohio Board of Regents;
- Jane Ensign, Director, Office of Curriculum and Instruction, Ohio Department of Education.

Those listed above provided vision and implementation support for the Transportation Systems Career Field Technical Content Standards and Ohio's transportation systems educational programs.

Also, special thanks are due to the following professional partners of this project:

- James Piper, Director, College Tech Prep Curriculum Services, University of Toledo;
- Mike Cowles, Consultant, Office of Career-Technical and Adult Education, Ohio Department of Education;
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The people listed above contributed significant research, subject matter, writing and facilitation expertise to the development of the Transportation Systems Career Field Technical Content Standards document.

Development of Transportation Systems Career Field Technical Content Standards

The process for the development of the *Transportation Systems Career Field Technical Content Standards* began in September 2005 with the convening of a futuring panel and culminated in April 2006 with the work of a panel of business representatives and educators focusing on academic correlation. Over the course of 2005-06, numerous business and industry representatives as well as secondary and postsecondary educators from across the state of Ohio took part in the formal development process. The following summarizes the various stages of the development process.

Futuring Panel

September 26, 2005

The Transportation Systems futuring panel brought together key business and industry representatives from across the state to advise the Ohio Department of Education and the Ohio Board of Regents on future trends impacting the transportation systems career field and to suggest ways in which those trends could be incorporated into a transportation systems career field technical content standards document.

Business Review Panels

November 4, 2005, and November 7, 2005

A diverse group of Ohio business and industry representatives participated on these panels. Drawn from various sectors and regions of the state, the panels identified what transportation employees should know and be able to do in the two transportation systems pathways: ground transportation and air transportation, and in the six career specialties. The panels built upon work outlined by the futuring panel, identifying essential and recommended knowledge and skills.

Educator Review Panels

December 2, 2005

These panels were composed of representatives from secondary and postsecondary institutions across Ohio. The panels determined *when* in the educational process (i.e., high school or college) competencies should be addressed and to *what depth*. In addition, the educator panels were asked to note questions they had on decisions made by the business review panel and to formulate suggestions for additions, deletions and editorial changes to the draft document. As it turned out, the educators' input was very compatible with the business review, and very few issues were raised.

Stakeholder Review Panels

December 2005 and January 2006

Since the educator panels raised very few issues, the stakeholder review was addressed electronically. The electronic review provided a forum to ensure that the final document facilitates the seamless education of students interested in pursuing a career in any of the two pathways or six career specializations.

Academic Review Panel

The academic review panel brought together business representatives, secondary and postsecondary technical educators with academic educators to identify benchmarks from the *Ohio Academic Content Standards for English Language Arts, Mathematics and Science* that are embedded within the technical competencies. This incorporation of academic content standards with career field technical content standards provides an opportunity for instructional integration of content, helping to contextualize learning for students and providing the basis for collaboration across disciplines.

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Philosophy and Principles for Implementation

Ohio Career Field Initiative

The overarching framework for Ohio career-technical education is outlined in the Ohio Revised Code and subsequent administrative rules, which specify career-technical programming based on 16 career fields. To view the full text of Administrative Rule 3301-61-03 (Criteria for Secondary Workforce Development Programs), go to: www.ode.state.oh.us. These 16 fields provide the framework for an Ohio career field initiative that seeks to foster the educational shift needed to respond to the needs of a rapidly changing global environment.

A career field is a “grouping of occupations and broad industries based on commonalities” (see www.careercluster.org). Career fields are the basis for developing both broad and specialized technical content standards that serve as a framework for curriculum, instruction, assessment and program design, addressing the needs of an entire industry and business sector. Ohio’s 16 career fields align with national efforts to broaden career-technical education, integrate career-technical with academic study and reflect the workforce needs of today and tomorrow. For today’s students to be adequately prepared for tomorrow’s workforce, they must have an education that:

- **incorporates a broad, long-term conception of work in combination with the depth of specialization skills;**
Employees need a comprehensive understanding beyond a single occupational area. Occupationally focused programming needs to be provided in a larger context, so students can generalize learning, make connections between education and work, and adapt to changes in their careers. Workplace knowledge and skills are needed to prepare employees for collaborating and problem solving while contributing to the broader business process.
- **emphasizes the acquisition of strong academic knowledge and skills; and**
Academic skills provide the foundation for career success. The integration of academic content standards with career field technical content standards helps to contextualize learning for students, making English language arts, mathematics and science relevant to students as a means to an important end—success at work and in life.
- **facilitates high-school-to-postsecondary transitions.**
A lifetime of change means a lifetime of learning, including postsecondary education. Students need knowledge and skills for success in a variety of postsecondary options, including apprenticeships, industry credentialing through adult education, two- and four-year college degree programs and graduate school.

Ohio Career Field Technical Content Standards

Career field technical content standards outline the knowledge and skills needed for success within a career field, multiple pathways and in some cases, areas of specialization. Validated by Ohio business and industry representatives in conjunction with Ohio educators, these standards form the basis for developing educational programming in Ohio secondary and postsecondary schools. The standards also serve as the framework for developing strong career pathways that connect secondary, adult and postsecondary education systems with the workplace.

While mirroring the diverse nature of each career field, all career field technical content standards documents will delineate competencies that outline the knowledge and skills that span the career field (core competencies), as well as those that relate to specific career field pathways (pathway competencies) and, in some cases, career field specialization (specialization competencies).

Additionally, academic benchmarks from Ohio's academic content standards for mathematics, science and English language arts are correlated with the career field technical content standards. The embedded benchmarks have been determined by business representatives and academic and technical educators from secondary and postsecondary institutions to be strongly related to specific knowledge and skills statements or competencies for the given career field.

Key features of Ohio Career Field Technical Content Standards include:

1. Broad as well as specialized technical competencies;
2. Embedded benchmarks for the English Language Arts, Mathematics and Science Academic Content Standards; and
3. Workplace readiness competencies (communications; safety, health and environment; problem solving and critical thinking; leadership, management and teamwork; information technology applications; ethics and legal responsibility; business foundations; and career development and employability).

Career Pathways

A key component of the Ohio Career Field Initiative is a career pathway, which is a series of academic and technical career-focused coursework and other learning experiences leading to a career specialty and employment in a career field. Pathways facilitate a seamless transition from high school to postsecondary education (including apprenticeships, adult education, two- and four-year colleges, and graduate school) and from postsecondary education to the workplace.

To effectively facilitate the transition from secondary to postsecondary education and a career, high school career pathways should encompass:

1. Challenging technical coursework in a chosen career field based on career field technical content standards;
2. Rigorous academics that meet Ohio's academic content standards and grade-level expectations;
3. Electives that relate to career objectives;
4. Instructional enhancements such as experiential and authentic learning opportunities (e.g. work-based learning, mentorships, internships) and career-technical student organization participation;

5. Opportunities (when appropriate) for program and student certification and licensure;
6. Preparation for transition to further study that includes college readiness and opportunities to earn college credit while in high school;
7. Preparation for transition to employment with advancement opportunities; and
8. Performance targets that include high school academic and technical testing/exit and postsecondary entry/placement requirements

For additional information on the Career Field Initiative, including Ohio Career Field Technical Content Standards and Career Pathways, go to www.ode.state.oh.us and search for “career field.”

STRUCTURE AND FORMAT

The Transportation Systems Career Field Technical Content Standards document is composed of a series of units, competencies and descriptors:

- *Units* are a grouping of competencies sharing a common subject or theme;
- *Competencies* are specific knowledge and skill statements that outline the knowledge and skills needed for career success; and
- *Descriptors* follow each competency and serve to define what is meant by the related competency.

Also included in the document are selected benchmarks from the Ohio's Academic Content Standards for English Language Arts, Mathematics and Science, which correlate with specific technical competencies. This incorporation of academic content standards with career field technical content standards provides an opportunity for instructional integration of content, helping to contextualize learning for students and providing the basis for collaboration across disciplines.

In addition, industry-driven, authentic assessments, based on the career-technical student organization SkillsUSA, are linked to various competencies and included in the appendix. This demonstrates the co-curricular nature of the career-technical student organization and provides an opportunity for authentic assessment of a student's knowledge and skills at the local, regional, state and national levels. Complete information on the assessments, including scoring rubrics, can be obtained at www.ohioskillsUSA.org.

Competencies that are common across the career field and/or are critical for success in the transportation systems career field are referred to as core competencies. These core competencies represent the sustaining characteristics of a career field and facilitate career readiness and long-term career success by:

- Providing the basis for effective collaboration, teamwork and communication across pathways;
- Laying the groundwork for successful transfer of knowledge and skills across pathways, thereby facilitating horizontal and vertical career success; and
- Equipping students and workers with the skills needed to transition to new and emerging careers throughout a working lifetime.

In the Transportation Systems document, core competencies include those focusing on:

- Career exploration and development
- Business foundations
- Communications
- Problem solving and critical thinking
- Leadership and teamwork
- Legal and ethical aspects
- Information technology
- Safety, health and environment
- Transportation fuels
- Transportation systems technical skill set

Pathway competencies are specific to one or several pathways within a larger career field. They differentiate the academic, technical and workplace knowledge and skills that are more specific than those that are relevant to the entire career field, yet they prepare students for multiple occupational specialties.

Specialization competencies are specific to occupational areas within the larger career pathway and career field. The Transportation Systems Career Field Technical Content Standards are built around two career pathways and multiple specialization areas:

- Ground transportation;
 - Automotive technician;
 - Collision repair technician;
 - Medium and heavy transportation equipment technology;
 - Power equipment technology;
- Air transportation;
 - Aviation maintenance technician;
 - Aviation technology.

Core, pathway and specialization competencies form the basis for developing secondary and postsecondary programs, facilitating transition from one educational level to the next and to the workplace.

In the Transportation Systems Career Field Technical Content Standards, business and labor representatives have designated competencies as *essential* or *recommended* within specific pathways and occupational areas. Educators have designated *when* (by the end of the 12th grade and/or associate degree or apprenticeship) and *to what depth* (introduced, reinforced, proficient) competencies should be addressed. Definitions used to make these designations appear on the following page, followed by a sample competency illustrating the layout of an actual competency.

DEFINITIONS AND CODES

Determined by Business, Industry and Labor (BIL) Panel

Essential (E) Competency:

E = Competency is needed to ensure minimal level of employability. Entry-level employees (defined as graduates of an associate degree program) should be able to perform this competency for career success.

Recommended (R) Competency:

R = Competency should be included but is not essential for minimal level of employability or is related only to a subspecialty within a pathway.

Determined by Educator (EDU) Panel

Grade Level:

12	=	by the end of grade 12
AD	=	by the end of the associate degree program

Depth:

I	=	Introduce competency
R	=	Reinforce, or add depth after introducing a competency OR after proficiency
P	=	Proficient or achievement of the competency; ability to apply knowledge of and/or perform the competency

Determined by Academic Review Panel

Correlated English Language Arts Academic Content Benchmarks

Benchmarks drawn from the *Ohio Academic Content Standards for English Language Arts* that have been determined to be embedded in the corresponding technical competency

Correlated Mathematics Academic Content Benchmarks

Benchmarks drawn from the *Ohio Academic Content Standards for Mathematics* that have been determined to be embedded in the corresponding technical competency

Correlated Science Academic Content Benchmarks

Benchmarks drawn from the *Ohio Academic Content Standards for Science* that have been determined to be embedded in the corresponding technical competency

Sample Competency

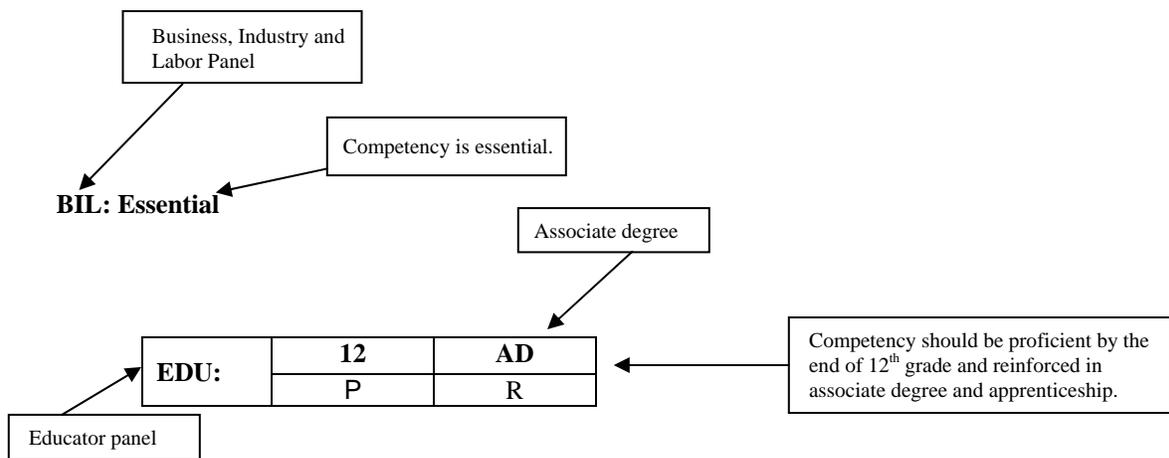
Unit 3: Communications

Industry-Driven Authentic Assessment: SkillsUSA (in appendix)

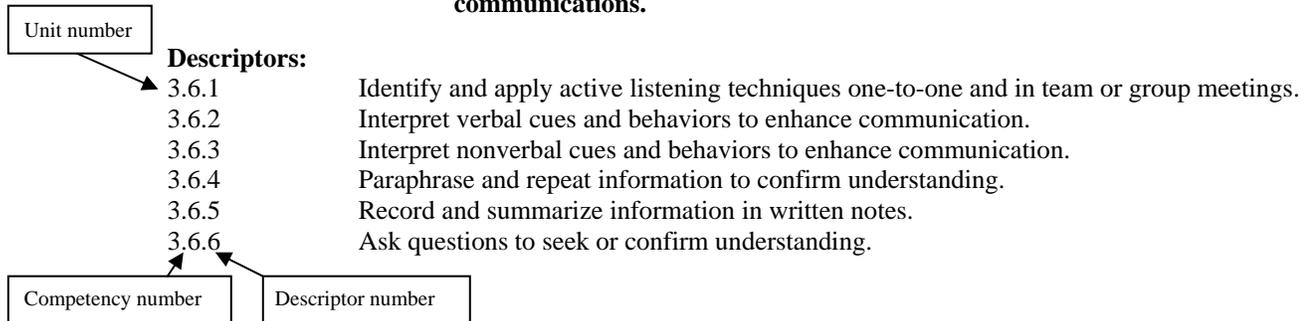
Prepared Speech – Evaluates each student’s ability to prepare and present clearly and effectively a series of thoughts relating to a central theme.

Extemporaneous Speaking – Evaluates each student’s ability to give a speech on an assigned topic with a minimum of advanced notice.

Job Interview – Evaluates students’ written, verbal and non-verbal skills in employment procedures when applying for a position.

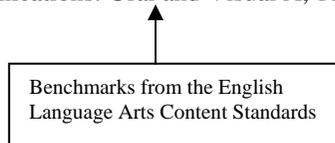


Competency 3.6: Apply active listening skills to obtain and clarify information provided in oral communications.



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)



Definitions

Transportation Systems

Drawing from the business processes of transportation, and integrating rigorous academics, this diverse career field exposes students to careers and businesses involved in the planning, management and movement of people and materials by ground and air. It also includes related professional and technical support services such as maintenance, compliance and environmental impacts.

Automotive Technician

This career specialization applies to the knowledge and skills to diagnose, repair, service and maintain all types of automotive vehicles. Preparation is provided for Automotive Service Excellence (ASE) testing in eight areas: suspension and steering, brakes, electrical and electronic systems, engine performance, engine repair, heating and air conditioning, automatic transmission and axle, and manual drive and drive train axles.

Sample careers:

Auto service technician (dealer)	Service operator and manager
Auto service technician (independent)	Service station technician
Manufacture specialist	Service writer
Parts technician and parts sales	

Collision Repair Technician

This career specialization applies to the knowledge and skills to diagnose, estimate and repair all types of vehicles. Preparation is provided in structural analysis and damage repair, non-structural analysis and damage repair, painting and refinishing, and mechanical and electrical components.

Sample careers:

Assembler	Manager and estimator
Body technician	Painter
Finisher	Recycling
Insurance adjuster	Repairer

Medium and Heavy Transportation Equipment Technician

This career specialization applies to the knowledge and skills to diagnose, repair, service and maintain all types of medium and heavy transportation equipment vehicles. Preparation is provided for Automotive Service Excellence (ASE) testing in eight areas: diesel engines, suspension and steering, brakes, electrical and electronic systems, preventive maintenance inspection, drive train, heating and air conditioning, and hydraulics.

Sample careers:

Entry level technician	Service manager
Journeyman technician	Service writer
Maintenance manager	Shop foreman

Power Equipment Technician

This career specialization applies to the knowledge and skills to diagnose, repair, service and maintain all types of small engines. Areas of concentration include two- and four-cycle engines; electrical theory; fuel systems; lubrication, cooling and motion drive systems; engine tune-up; power takeoff accessories; and troubleshooting.

Sample careers:

Construction equipment mechanic
Diesel engine repair technician
Marine mechanic
Mechanic helper
Motorcycle mechanic

New equipment assembler
Parts person
Small engine mechanic
Truck mechanic
Used equipment restorer

Aviation Maintenance Technician

This career specialization applies to the knowledge and skills in the airframe, power-plant and combined airframe and power-plant curriculum areas. It is designed to prepare students to obtain an airframe or power-plant rating for employment in the aviation industry. The Federal Aviation Regulation 147 (FAR 147) outlines specific hours, curriculum and instructional standards for aviation maintenance technicians.

Sample careers:

Aircraft detailer
Airframe mechanic
Aviation maintenance technician

Line service
Power plant mechanic

Aviation Technology

This career specialization applies to aviation knowledge and skills other than maintenance. Areas of concentration include aircraft systems and technology, airport environment, meteorology, aerodynamics, and air traffic control.

Sample careers:

Air traffic controller
Aircraft records
Airfield maintenance
Flight attendant
Flight dispatcher
Inspection quality control and quality assurance

Loadmaster
Navigational maintenance
Pilots
Regulations and surveillance
Schedulers (operations)
Transportation security

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

Competency	12	AD	BIL
Transportation Systems Core Body of Knowledge			
Unit 1: Career Exploration and Development			
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
Unit 2: Business Foundations			
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
Unit 3: Communications			
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

Competency		12	AD	BIL
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
Unit 4: Problem Solving and Critical Thinking				
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
Unit 5: Leadership and Teamwork				
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
Unit 6: Legal and Ethical Aspects				
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
Unit 7: Information Technology Applications				
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
Unit 8: Safety, Health and Environmental Aspects				
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

Competency		12	AD	BIL
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
Unit 9: Transportation Fuels				
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
Unit 10: Transportation Systems Technical Skills Sets				
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
GROUND TRANSPORTATION PATHWAY				
Automotive Technician				
Unit 11: Orientation to the Automotive Industry				
11.1	Define the industry.	P	R	E
11.2	Determine the skills needed to work in the automotive industry.	P	R	E
Unit 12: Tools and Equipment				
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
Unit 13: Engine Repair				
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
Unit 14: Automatic Transmission and Transaxle				
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
Unit 15: Manual Drive Train and Axles				
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

Competency	12	AD	BIL
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
Unit 16: Suspension and Steering			
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
Unit 17: Brakes			
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
Unit 18: Electrical and Electronic Systems			
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
Unit 19: Heating and Air Conditioning (A/C)			
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
Unit 20: Engine Performance			
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

Competency	12	AD	BIL
Unit 21: Emissions Control Systems Diagnosis and Repair			
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
Collision Repair Technician			
Unit 22: Orientation to the Collision Repair Industry			
22.1 Analyze and explain the scope, trends and issues in the collision repair industry.	P	R	E
22.2 Determine the skills needed to work in the collision repair industry.	P	R	E
Unit 23: Tools and Equipment			
23.1 Identify basic tools and equipment appropriate to the collision repair industry.	P	R	E
23.2 Demonstrate the appropriate use of basic hand tools to complete work functions.	P	R	E
23.3 Operate power tools and stationary equipment.	P	R	E
23.4 Maintain hand and power tools appropriate to the collision repair industry.	P	R	E
23.5 Use appropriate personal protective equipment (PPE).	P	R	E
Unit 24: Collision Repair Basics			
24.1 Access needed information using available references and resources.	I	P	E
24.2 Perform basic collision-related mechanical skills.	I	P	E
24.3 Prepare and explain estimates.	I	P	E
24.4 Identify and acquire parts.	I	P	E
Unit 25: Structural Analysis and Damage Repair			
25.1 Inspect, diagnose and repair full frame vehicles.	I	P	E
25.2 Inspect, diagnose, measure and repair unibody vehicles.	I	P	E
25.3 Perform fixed glass repair.	I	P	E
25.4 Weld and cut materials for collision repair.	P	R	E
Unit 26: Non-Structural Analysis and Damage Repair			
26.1 Organize repair preparation.	P	R	E
26.2 Perform outer body panel repairs, replacements and adjustments.	I	P	E
26.3 Perform metal finishing and body filling.	P	R	E
26.4 Repair moveable glass and hardware.	I	P	E
26.5 Perform metal welding and cutting.	P	R	E
26.6 Repair plastics and adhesives.	I	P	E
Unit 27: Mechanical and Electrical Components			
27.1 Inspect, diagnose and repair suspension and steering.	I	P	E
27.2 Diagnose and perform electrical repairs.	I	P	E
27.3 Diagnose and perform repairs to brake systems.	I	P	E
27.4 Diagnose and repair heating and air conditioning (A/C) systems.	I	P	E
27.5 Diagnose and repair cooling systems.	I	P	E
27.6 Diagnose and repair drive train.	I	P	E
27.7 Diagnose and repair fuel, intake and exhaust systems.	I	P	E
27.8 Diagnose and repair restraint systems.	I	P	E
Unit 28: Painting and Refinishing			
28.1 Demonstrate safety precautions.	P	R	E
28.2 Prepare surface for refinishing.	P	R	E

Competency	12	AD	BIL
28.3 Properly operate spray gun and related equipment.	P	R	E
28.4 Mix, match and apply paint.	I	P	E
28.5 Identify and correct paint defects.	I	P	E
28.6 Perform final detailing.	P	R	E
Medium and Heavy Transportation Equipment Technology			
Unit 29: Orientation to the Medium and Heavy Transportation Industry			
29.1 Analyze the scope, trends, and issues in the medium and heavy transportation industry.	I	P	E
29.2 Determine the skills needed to work in the medium and heavy transportation industry.	I	P	E
Unit 30: Tools and Equipment			
30.1 Identify basic tools and equipment appropriate to the medium/heavy transportation industry.	P	R	E
30.2 Demonstrate appropriate use of basic hand tools to complete work functions.	P	R	E
30.3 Operate power tools and stationary equipment.	I	P	E
30.4 Maintain hand and power tools appropriate to the medium/heavy transportation industry.	P	R	E
30.5 Use appropriate personal protective equipment (PPE).	P	R	E
Unit 31: Medium and Heavy Transportation Basics			
31.1 Perform basic mechanical skills.	I	P	E
31.2 Perform basic welding and cutting tasks.	I	P	E
Unit 32: Diesel Engines			
32.1 Perform general engine diagnosis and determine needed action.	I	P	E
32.2 Diagnose and repair cylinder head and valve train.	I	P	E
32.3 Diagnose and repair engine block.	I	P	E
32.4 Diagnose and repair lubrication system.	I	P	E
32.5 Diagnose and repair cooling system.	I	P	E
32.6 Diagnose and repair air induction and exhaust systems.	I	P	E
32.7 Diagnose and repair fuel system.	I	P	E
32.8 Diagnose and repair mechanical fuel injection.	I	P	E
32.9 Diagnose and repair electronic fuel management system.	I	P	E
32.10 Inspect and adjust engine brakes.	I	P	E
Unit 33: Drive Train			
33.1 Diagnose and repair clutch.	I	P	E
33.2 Diagnose and repair transmission.	I	P	E
33.3 Diagnose and repair driveshaft and universal joint.	I	P	E
33.4 Diagnose and repair drive axle.	I	P	E
Unit 34: Brakes			
34.1 Diagnose and repair air brakes.	I	P	E
34.2 Diagnose and repair mechanical and foundation brakes.	I	P	E
34.3 Diagnose and repair parking brakes.	I	P	E
Unit 35: Hydraulic Brakes			
35.1 Diagnose and repair hydraulic brakes.	I	P	E
35.2 Diagnose and repair mechanical and foundation brakes.	I	P	E
35.3 Diagnose and repair power assist units.	I	P	E
35.4 Diagnose and service air and hydraulic antilock brake systems (ABS) and automatic traction control (ATC).	I	P	E

Competency	12	AD	BIL
Unit 36: Suspension and Steering			
36.1 Diagnose and repair steering column.	I	P	E
36.2 Diagnose and repair steering units.	I	P	E
36.3 Diagnose and repair steering linkage.	I	P	E
36.4 Diagnose and repair suspension systems.	I	P	E
36.5 Diagnose, adjust and repair wheel alignment.	I	P	E
36.6 Diagnose and repair wheels and tires.	I	P	E
36.7 Diagnose and repair frame.	I	P	E
Unit 37: Electrical and Electronic Systems			
37.1 Diagnose general electrical systems.	I	P	E
37.2 Diagnose and repair battery.	I	P	E
37.3 Diagnose and repair starting system.	I	P	E
37.4 Diagnose and repair charging system.	I	P	E
37.5 Diagnose and repair lighting system.	I	P	E
37.6 Diagnose and repair gauges and warning devices.	I	P	E
37.7 Diagnose and repair related electrical systems.	I	P	E
Unit 38: Heating, Ventilation and Air Conditioning (HVAC)			
38.1 Diagnose, service and repair HVAC systems.	I	P	E
38.2 Diagnose, service and repair air conditioning (A/C) system and components.	I	P	E
38.3 Diagnose, service and repair heating and engine cooling systems.	I	P	E
38.4 Diagnose, service and repair operating systems and related electrical controls.	I	P	E
38.5 Diagnose, service and repair operating systems and related air, vacuum and mechanical controls.	I	P	E
38.6 Recover, recycle and handle refrigerant.	I	P	E
Unit 39: Preventive Maintenance Inspection			
39.1 Perform preventative engine system maintenance.	I	P	E
39.2 Perform preventative fuel system maintenance.	I	P	E
39.3 Perform preventative air induction and exhaust system maintenance.	I	P	E
39.4 Perform preventative cooling system maintenance.	I	P	E
39.5 Perform preventative lubrication system maintenance.	I	P	E
39.6 Perform preventative instruments and controls maintenance.	I	P	E
39.7 Perform preventative safety equipment maintenance.	I	P	E
39.8 Perform preventative hardware maintenance.	I	P	E
39.9 Perform preventative heating, ventilation and air conditioning (HVAC) maintenance.	I	P	E
39.10 Perform preventative battery and starting systems maintenance.	I	P	E
39.11 Perform preventative charging system maintenance.	I	P	E
39.12 Perform preventative lighting system maintenance.	I	P	E
39.13 Perform preventative air brakes maintenance.	I	P	E
39.14 Perform preventative hydraulic brakes maintenance.	I	P	E
39.15 Perform preventative drive train maintenance.	I	P	E
39.16 Perform preventative suspension and steering systems maintenance.	I	P	E
39.17 Perform preventative tires and wheels maintenance.	I	P	E
39.18 Perform preventative frame and fifth wheel maintenance.	I	P	E

Competency	12	AD	BIL
Unit 40: Hydraulics			
40.1 Perform general system operations.	I	R	R
40.2 Diagnose and repair pumps.	I	R	R
40.3 Diagnose and repair filtration system and reservoirs (tanks).	I	R	R
40.4 Diagnose and replace hoses, fittings and connections.	I	R	R
40.5 Diagnose and repair control valves.	I	R	R
40.6 Diagnose and repair actuators.	I	R	R
Power Equipment Technology			
Unit 41: Power Equipment Overview			
41.1 Analyze the scope, trends and issues in the power equipment industry.	P	R	E
41.2 Determine the skills needed to work in the power equipment industry.	P	R	E
Unit 42: Tools and Equipment			
42.1 Identify basic tools and equipment appropriate to power technology.	P	R	E
42.2 Utilize test equipment in service operations.	P	R	E
42.3 Demonstrate the appropriate use of basic hand tools to complete work functions.	P	R	E
42.4 Operate power tools and stationary equipment.	P	R	E
42.5 Maintain hand and power tools appropriate to power technology.	I	P	E
42.6 Use appropriate personal protective equipment (PPE).	P	R	E
Unit 43: Service Operations			
43.1 Locate, interpret and utilize parts and service information.	P	R	E
43.2 Remove and install engines to manufacturer's technical manual.	I	P	E
43.3 Explain four-cycle engine theory.	P	R	E
43.4 Explain two-cycle engine theory.	P	R	E
43.5 Disassembly, inspect, service and reassemble two-cycle and four-cycle engines to manufacturer's technical manual.	P	R	E
43.6 Explain basic electrical theory.	I	P	E
43.7 Explain basic ignition system theory.	I	P	E
43.8 Inspect and service ignition systems.	P	R	E
43.9 Explain carburetion theory.	P	R	E
43.10 Explain fuel injection theory.	P	R	E
43.11 Explain the composition and inspection of fuels.	I	P	E
43.12 Inspect and service fuel systems.	P	R	E
43.13 Diagnose and repair fuel system.	I	P	E
43.14 Diagnose and repair mechanical fuel injection.	I	P	E
43.15 Explain alternative fuel systems.	I	P	E
43.16 Explain turbocharged induction.	P	R	E
43.17 Explain supercharged induction.	P	R	E
43.18 Inspect and service governor systems.	I	P	E
43.19 Explain the composition of the various oils used for lubrication.	P	R	E
43.20 Inspect and service lubrication systems to manufacturer's specifications.	P	R	E
43.21 Describe the function and operation of the cooling system.	P	R	E
43.22 Inspect and service cooling systems.	P	R	E
43.23 Inspect and service lighting, accessory, and charging systems.	I	P	E
43.24 Inspect and service batteries.	P	R	E
43.25 Perform gas and diesel engine tune-up.	P	R	E
43.26 Analyze the various power takeoff (PTO) accessories.	I	P	E

Competency	12	AD	BIL
43.27 Inspect and adjust power takeoff (PTO) accessories.	P	R	E
43.28 Analyze the operational features of motion drive systems.	P	R	E
43.29 Inspect and service motion drive systems.	I	P	E
43.30 Analyze the operational features of frame, suspension and steering systems.	I	P	E
43.31 Inspect and service frame, suspension and steering systems.	I	P	E
43.32 Inspect and service tires, wheels and brakes.	P	R	E
43.33 Service multi-cylinder engines to manufacturer's specifications.	P	R	E
43.34 Perform equipment maintenance and storage to manufacturer's specifications.	P	R	E
43.35 Demonstrate welding, soldering and heat-treating operations.	I	P	R
AIR TRANSPORTATION PATHWAY			
Aviation Maintenance Technician			
Unit 44: Orientation to Aviation Maintenance			
44.1 Analyze the scope, trends and issues in the aviation industry.	I	P	E
44.2 Determine the skills needed to work in the aviation industry.	I	P	R
Unit 45: General Aviation			
45.1 Assess basic electricity concepts.	I	P	E
45.2 Utilize aircraft drawings.	I	P	E
45.3 Assess weight and balance.	I	P	E
45.4 Fabricate fluid lines and fittings.	I	P	E
45.5 Evaluate materials and perform processes.	I	P	E
45.6 Demonstrate ground operation and servicing.	I	P	E
45.7 Demonstrate cleaning and corrosion control.	I	P	E
45.8 Integrate mathematics.	P	R	E
45.9 Complete maintenance forms and records.	I	P	E
45.10 Utilize basic physics.	I	P	E
45.11 Utilize maintenance publications.	I	P	E
45.12 Exercise mechanics' privileges and limitations.	I	P	E
Unit 46: Airframe Structures			
46.1 Perform wood structure maintenance.	I	P	E
46.2 Perform aircraft covering maintenance.	I	P	E
46.3 Apply aircraft finishes.	I	P	E
46.4 Evaluate and repair sheet metal and non-metallic structures.	I	P	E
46.5 Demonstrate welding operations.	I	P	E
46.6 Demonstrate assembly and rigging operations.	I	P	E
46.7 Complete airframe inspection.	I	P	E
Unit 47: Airframe Systems and Components			
47.1 Evaluate and repair aircraft landing gear systems.	I	P	E
47.2 Evaluate and repair hydraulic and pneumatic power systems.	I	P	E
47.3 Evaluate and service cabin atmosphere control systems.	I	P	E
47.4 Troubleshoot and repair aircraft instrument systems.	I	P	E
47.5 Evaluate and repair communication and navigation systems.	I	P	E
47.6 Evaluate and service aircraft fuel systems.	I	P	E
47.7 Evaluate and service aircraft electrical systems.	I	P	E
47.8 Evaluate and service position and warning systems.	I	P	E

Competency	12	AD	BIL
47.9 Evaluate and service ice and rain control systems.	I	P	E
47.10 Evaluate and service fire protection systems.	I	P	E
47.11 Describe avionics systems.	I	P	E
Unit 48: Powerplant Theory and Maintenance			
48.1 Evaluate and service reciprocating engines.	I	P	E
48.2 Evaluate and service turbine engines.	I	P	E
48.3 Complete engine inspection.	I	P	E
Unit 49: Powerplant Systems and Components			
49.1 Evaluate and service engine instrument systems.	I	P	E
49.2 Evaluate and service engine fire protection systems.	I	P	E
49.3 Evaluate and service engine electrical systems.	I	P	E
49.4 Evaluate and service lubrication systems.	I	P	E
49.5 Evaluate and service ignition and starting systems.	I	P	E
49.6 Evaluate and service fuel metering systems.	I	P	E
49.7 Evaluate and service engine fuel systems.	I	P	E
49.8 Evaluate and service induction and engine airflow systems.	I	P	E
49.9 Evaluate and service engine cooling systems.	I	P	E
49.10 Evaluate and service engine exhaust and reverser systems.	I	P	E
49.11 Evaluate and service propellers.	I	P	E
49.12 Inspect and troubleshoot unducted fan systems and components.	I	P	E
49.13 Assess auxiliary power unit.	I	P	E
Aviation Technology			
Unit 50: Overview			
50.1 Explain the historical evolution of air transportation.	I	R	R
50.2 Explain the structure of the air transportation industry.	I	P	E
50.3 Explain the numerous careers and respective training for the air transportation industry.	I	P	E
50.4 Identify the various aerospace organizations.	I	P	E
50.5 Examine the regulatory framework of aviation.	I	R	R
Unit 51: Types of Aviation			
51.1 Examine the aspects of general aviation.	I	P	R
51.2 Identify the aspects of commercial aviation.	I	P	R
51.3 Examine the aspects of military aviation.	I	P	R
51.4 Identify fixed base operators and their role in general aviation.	I	P	R
51.5 Explain business and commercial aviation.	I	P	R
51.6 Explain the use of helicopters.	I	P	R
51.7 Explain the evolution of jet transportation.	I	P	R
Unit 52: Aircraft Systems and Technology			
52.1 Describe the powerplant and related systems.	I	P	E
52.2 Examine the aircraft instruments.	I	P	E
Unit 53: Airport Environment			
53.1 Examine the national airport network.	I	P	E
53.2 Explain airport design.	I	P	E
Unit 54: Air Traffic Control and Communication			
54.1 Explore sources for air traffic control (ATC) information.	I	P	E
54.2 Analyze radar and ATC services.	I	P	E
54.3 Explain radio procedures.	I	P	E

Competency	12	AD	BIL
Unit 55: Meteorology			
55.1 Discuss the atmosphere and atmospheric elements.	I	P	E
55.2 Explain basic weather theory.	I	P	E
55.3 Interpret weather patterns.	I	P	E
55.4 Discuss weather hazards.	I	P	E
55.5 Interpret weather data.	I	P	E
55.6 Describe the printed weather reports and forecasts.	I	P	E
55.7 Describe graphic weather products.	I	P	E
55.8 Identify sources of weather information.	I	P	E
Unit 56: Flight Environment			
56.1 Identify and define the rules of flight.	I	P	E
56.2 Explain the grid system used in navigation.	I	P	E
56.3 Explain the pilotage and dead-reckoning methods of navigation.	I	P	E
56.4 Explain the VHF omni-directional range (VOR) navigation system.	I	P	E
56.5 Explain the automatic direction finding (ADF) navigation systems.	I	P	E
56.6 Discuss advanced navigation systems.	I	P	E
56.7 Explain the classification and control of airspace.	I	P	E
Unit 57: Aerodynamics			
57.1 Describe the basics of aeronautics and aerodynamics.	I	P	E
57.2 Describe aerodynamic principles.	I	P	E
57.3 Explain the aerodynamic principle of stability.	I	P	E
57.4 Explain the aerodynamics of maneuvering flight.	I	P	E
57.5 Explain aircraft performance factors.	I	P	E
57.6 Discuss advances in aeronautics.	I	P	R
Unit 58: Aviation Human Factors			
58.1 Explore aviation physiology.	I	P	E
58.2 Analyze aeronautical decision-making.	I	P	E
Unit 59: Safety			
59.1 Analyze the importance of safety compliance management in accident prevention.	I	P	E
59.2 Distinguish between security and safety.	I	P	E
59.3 Analyze the impact of safety data analysis on aviation safety.	I	P	E
59.4 Explain the nature of the human factor on accidents.	I	P	E
59.5 Explain strategies to manage human error.	I	P	E
59.6 Describe the impact of air traffic systems on safety.	I	P	E
59.7 Explain the role of the National Transportation Safety Board (NTSB) in accident investigations.	I	P	E
59.8 Describe flight standards and rulemaking policies.	I	P	E
Unit 60: Rocket Fundamentals			
60.1 Evaluate the role rockets play in the aviation industry.	I	P	R
60.2 Explain the fundamental concept of chemical propulsion.	I	P	R
60.3 Explore orbits and trajectories.	I	P	R
Unit 61: Space Environment			
61.1 Explore the space environment.	I	P	R
61.2 Examine our solar system.	I	P	R
61.3 Summarize unmanned space exploration.	I	P	R
61.4 Summarize manned space exploration.	I	P	R

Competency	12	AD	BIL
Unit 62: Management			
62.1 Summarize the structure and function of aviation-based businesses and services.	I	P	R
62.2 Describe management concepts.	I	P	E
62.3 Manage human resources.	I	P	R
62.4 Perform personnel staffing functions.	I	P	R
62.5 Conduct orientation and training sessions.	I	P	R
62.6 Discuss leadership principles in aviation-based businesses and services.	I	P	E
62.7 Explain how planning and budgeting are used to accomplish organizational goals and objectives.	I	P	R
62.8 Explore budgeting skills to determine staffing levels.	I	P	R
62.9 Explain the nature and scope of finance and controlling functions.	I	P	R
62.10 Explain basic accounting concepts and principles.	I	P	R
62.11 Establish criteria for purchasing products and services.	I	I	R
62.12 Explain material control and product inventories necessary to meet customer and business requirements.	I	I	R
62.13 Manage customer relationships.	I	P	E
62.14 Examine risk management.	I	P	R
62.15 Describe business risks.	I	P	R
62.16 Complete a business plan.	I	P	E
Unit 63: Marketing Functions			
63.1 Examine marketing and its role in an aviation-based businesses and services.	I	P	E
63.2 Complete a marketing plan.	I	P	E
63.3 Describe the promotion function.	I	P	E
63.4 Identify targeted markets.	I	P	E
63.5 Explain the sales cycle.	I	P	R
63.6 Explain the role of customer service as a component of marketing relationships.	I	P	E
63.7 Describe selling processes and techniques.	I	P	E
63.8 Describe sales support activities.	I	P	R
63.9 Manage selling activities.	I	P	R
63.10 Evaluate pricing fundamentals.	I	P	E
63.11 Evaluate pricing strategies.	I	P	E

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TRANSPORTATION SYSTEMS
CORE BODY OF KNOWLEDGE

UNITS 1 - 10

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 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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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**

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	I	R

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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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**

EDU:	12	AD
	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

EDU:	12	AD
	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**

EDU:	12	AD
	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**

EDU:	12	AD
	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**

EDU:	12	AD
	I	P

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**

EDU:	12	AD
	I	P

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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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 hard response approach (e.g. force, threats, aggression and anger) and the typical reasons for using that approach.
- 5.5.3 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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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**

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	I	P

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)

BIL: Essential

EDU:	12	AD
	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

EDU:	12	AD
	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**

EDU:	12	AD
	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**

EDU:	12	AD
	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**

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	I	P

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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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 technician might be called upon to perform.
- 10.7.4 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)

GROUND TRANSPORTATION PATHWAY

UNITS 11 - 43

AUTOMOTIVE TECHNICIAN

UNITS 11 - 21

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 11.1: 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

EDU:	12	AD
	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

EDU:	12	AD
	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**

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	I	P

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**

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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**

EDU:	12	AD
	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**

EDU:	12	AD
	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

EDU:	12	AD
	I	P

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 action [P-1].
- 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

EDU:	12	AD
	I	P

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 Inspect 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

EDU:	12	AD
	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**

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	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

EDU:	12	AD
	I	P

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

EDU:	12	AD
	I	P

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)
- *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**

EDU:	12	AD
	I	P

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

EDU:	12	AD
	I	P

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

EDU:	12	AD
	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**

EDU:	12	AD
	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

EDU:	12	AD
	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)
- *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 18.8: 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)
- *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 18.9: 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**

EDU:	12	AD
	I	P

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, customer concern, related service history, cause and correction [P-1].
- 19.1.3 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

EDU:	12	AD
	I	P

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**

EDU:	12	AD
	I	P

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

EDU:	12	AD
	I	P

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

EDU:	12	AD
	I	P

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

EDU:	12	AD
	I	P

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

EDU:	12	AD
	I	P

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**

EDU:	12	AD
	I	P

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

EDU:	12	AD
	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**

EDU:	12	AD
	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**

EDU:	12	AD
	I	P

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

EDU:	12	AD
	I	P

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

EDU:	12	AD
	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)

COLLISION REPAIR TECHNICIAN

UNITS 22 - 28

Collision Repair Technician

High Priority Individual = HP-I

High Priority Group = HP-G

Unit 22: Orientation to the Collision Repair Industry

BIL: Essential

EDU:	12	AD
	P	R

Competency 22.1: Analyze and explain the scope, trends and issues in the collision repair industry.

Descriptors:

- 22.1.1 Present an overview of the collision repair industry.
Identify trends and issues that affect the collision repair industry.
- 22.1.2 Identify the professional or trade associations related to the collision repair industry.
- 22.1.3 Identify areas of specialization and related occupations within the collision repair industry.
- 22.1.4 Identify employment opportunities in the collision repair 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)

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)
- *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 22.2: Determine the skills needed to work in the collision repair industry.

Descriptors:

- 22.2.1 Match collision repair occupational job titles with qualifications and responsibilities.
- 22.2.2 Identify the education, training and certification required to work in the various collision repair fields.
- 22.2.3 Describe the kinds of work techniques, processes and procedures a typical collision repair technician might be called upon to perform.

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 23: Tools and Equipment

BIL: Essential

EDU:	12	AD
	P	R

Competency 23.1: Identify basic tools and equipment appropriate to the collision repair industry.

Descriptors:

- 23.1.1 Identify the various types of tools and equipment applicable to the collision repair application.
- 23.1.2 Describe the primary functions of various types of hand and power tools.
- 23.1.3 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

EDU:	12	AD
	P	R

Competency 23.2: Demonstrate the appropriate use of basic hand tools to complete work functions.

Descriptors:

- 23.2.1 Identify potential hazards and limitations related to the use of tools.
- 23.2.2 Demonstrate basic measuring tools.

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)

BIL: Essential

EDU:	12	AD
	P	R

Competency 23.3: Operate power tools and stationary equipment.

Descriptors:

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

BIL: Essential

EDU:	12	AD
	P	R

Competency 23.4: Maintain hand and power tools appropriate to the collision repair industry.

Descriptors:

- 23.4.1 Conduct routine inspections of hand tools and power equipment.
- 23.4.2 Troubleshoot maintenance problems in accordance with established procedures.
- 23.4.3 Perform preventive maintenance in accordance with guidelines specified by the manufacturer and/or outside authorities with jurisdiction (e.g., OSHA).
- 23.4.4 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 23.5: Use appropriate personal protective equipment (PPE).

Descriptors:

- 23.5.1 Identify the appropriate personal protective equipment (PPE) to wear with specific transportation tasks, and identify the consequences of non-compliance.
- 23.5.2 Discuss various conditions that workers encounter, and match the appropriate PPE to each situation.
- 23.5.3 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 24: Collision Repair Basics

Note: Throughout Unit 24, students are expected to learn and use vocabulary specific to the collision repair 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 24.1: Access needed information using available references and resources.

Descriptors:

- 24.1.1 Identify available resources (e.g., manufacturers' specifications, videos, online information systems, service manuals, parts manuals, company procedure manuals and collision estimating guides).
- 24.1.2 Utilize the reference materials and resources appropriate for a given task.
- 24.1.3 Interpret reference materials and resources.
- 24.1.4 Interpret charts, graphs, schematics, illustrations, scan displays, printouts and tables.

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)
- *Analyze whether graphics supplement textual information and promote the author's purpose.* (Reading: Informational, Technical and Persuasive Text 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)

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)
- *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 24.2: Perform basic collision-related mechanical skills.

Descriptors:

- 24.2.1 Drill holes.
- 24.2.2 Demonstrate tap and die techniques, including the repair of damaged threads.
- 24.2.3 Sharpen drill bits and chisels.
- 24.2.4 Extract broken screws.
- 24.2.5 Demonstrate flaring techniques (single and double).
- 24.2.6 Assemble hydraulic and pneumatic hose and tubing.
- 24.2.7 Perform wire connection techniques, including soldering, crimping and insulating.
- 24.2.8 Utilize appropriate fasteners and fastening tools (e.g., wrenches, pliers).

BIL: Essential

EDU:	12	AD
	I	P

Competency 24.3: Prepare and explain estimates.

Descriptors:

- 24.3.1 Ensure the accuracy of estimates.
- 24.3.2 Calculate labor, material, miscellaneous repair costs and taxes.
- 24.3.3 Communicate technical information to a customer.
- 24.3.4 Interpret vehicle identification number (VIN) codes.
- 24.3.5 Interpret code tags for accessories.
- 24.3.6 Establish the value of the vehicle.
- 24.3.7 Organize damage reports.
- 24.3.8 Prepare computerized estimates.
- 24.3.9 Differentiate between repair and replace using conjunctive repair principals and considering paintless dent repair (PDR).
- 24.3.10 Determine when to use original equipment from manufacturer (OEM), aftermarket or recycled parts.
- 24.3.11 Locate hidden damage.
- 24.3.12 Assess sublet repairs.
- 24.3.13 Document unrelated prior damage.
- 24.3.14 Identify the paint type used on a given vehicle.
- 24.3.15 Maintain awareness of prevailing rates.
- 24.3.16 Summarize the final estimate for the customer.
- 24.3.17 Write repair work orders.
- 24.3.18 Comply with notification laws regarding replacement parts.

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)
- *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

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

EDU:	12	AD
	I	P

Competency 24.4: Identify and acquire parts.

Descriptors:

- 24.4.1 Collect necessary information (e.g., make, model, year, option codes, vehicle identification number [VIN]).
- 24.4.2 Identify additional damage after disassembly.
- 24.4.3 Convey information to parts person.
- 24.4.4 Confirm that the parts received are correct.
- 24.4.5 Verify part price and availability.
- 24.4.6 Determine all available resource options for parts.

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.* (Research B, 8-10)

Unit 25: Structural Analysis and Damage Repair

Note: Throughout Unit 25, students are expected to learn and use vocabulary specific to the collision repair 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 25.1: Inspect, diagnose and repair full frame vehicles.

Descriptors:

- 25.1.1 Diagnose and measure structural damage using tram and self-centering gauges [HP-I].
- 25.1.2 Attach vehicle to anchoring devices [HP-I].
- 25.1.3 Analyze, straighten and align mash (collapse) damage [HP-G].
- 25.1.4 Analyze, straighten and align sag damage [HP-G].
- 25.1.5 Analyze, straighten and align sidesway damage [HP-G].
- 25.1.6 Analyze, straighten and align twist damage [HP-G].
- 25.1.7 Analyze, straighten and align diamond frame damage [HP-G].
- 25.1.8 Remove and replace damaged structural components [HP-I].
- 25.1.9 Restore corrosion protection to repaired or replaced frame areas [HP-I].
- 25.1.10 Analyze and identify misaligned or damaged steering, suspension and powertrain components that can cause vibration, steering and wheel alignment problems [HP-I].
- 25.1.11 Align or replace misaligned or damaged steering, suspension and powertrain components that can cause vibration, steering and wheel alignment problems [HP-G].
- 25.1.12 Identify heat limitations in structural components [HP-I].
- 25.1.13 Restore structural form [HP-G].
- 25.1.14 Diagnose and measure structural damage using a universal measuring system (mechanical, electrical, laser) [HP-G].
- 25.1.15 Diagnose and measure structural damage to vehicles using a dedicated (fixture) measuring system [HP-G].
- 25.1.16 Determine the extent of the direct and indirect damage and the direction of impact; document the methods and sequence of repair [HP-I].
- 25.1.17 Analyze and identify crush/collapse zones [HP-I].

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)
- *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)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 25.2: Inspect, diagnose, measure and repair unibody vehicles.

Descriptors:

- 25.2.1 Analyze and identify misaligned or damaged steering, suspension and powertrain components that can cause vibration, steering and chassis alignment problems [HP-I].
- 25.2.2 Realign or replace misaligned or damaged steering, suspension and powertrain components that can cause vibration, steering and chassis alignment problems [HP-G].
- 25.2.3 Diagnose and measure unibody damage using a tram and self-centering gauges [HP-I].
- 25.2.4 Determine and inspect the locations of all suspension, steering and power train component attaching points on the vehicle [HP-G].
- 25.2.5 Diagnose and measure unibody vehicles using a dedicated (fixture) measuring system [HP-G].
- 25.2.6 Diagnose and measure unibody vehicles using a universal measuring system (e.g., mechanical, electronic, laser) [HP-G].
- 25.2.7 Determine the extent of the direct and indirect damage and the direction of impact; plan and document the methods and sequence of repair [HP-I].
- 25.2.8 Attach anchoring devices to vehicle; remove or reposition components as necessary [HP-I].
- 25.2.9 Straighten and align cowl assembly [HP-G].
- 25.2.10 Straighten and align roof rails/headers and roof panels [HP-G].
- 25.2.11 Straighten and align hinge and lock pillars [HP-G].
- 25.2.12 Straighten and align vehicle openings, floor pans and rocker panels [HP-G].
- 25.2.13 Straighten and align quarter panels, wheelhouse assemblies and rear body sections (including rails and suspension/power train mounting points [HP-G].
- 25.2.14 Straighten and align front-end sections (aprons, strut towers, upper and lower rails, steering and suspension/power train mounting points, etc.) [HP-G].

- 25.2.15 Identify heat limitations in unibody vehicles [HP-I].
- 25.2.16 Identify proper cold stress relief methods [HP-I].
- 25.2.17 Repair damage using power tools and hand tools to restore proper contours and dimensions [HP-I].
- 25.2.18 Remove and replace damaged sections of structural steel body panels [HP-G].
- 25.2.19 Restore corrosion protection to repaired or replaced unibody structural areas [HP-I].
- 25.2.20 Determine the extent of damage to aluminum structural components; repair, weld or replace [HP-G].
- 25.2.21 Analyze and identify crush/collapse zones [HP-I].

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)
- *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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 25.3: Perform fixed glass repair.

Descriptors:

- 25.3.1 Remove and reinstall or replace fixed glass (heated and non-heated) using recommended materials [HP-G].
- 25.3.2 Remove and reinstall or replace modular glass using recommended materials [HP-G].

Correlated Mathematics Academic Content Benchmarks

- *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
	P	R

Competency 25.4: Weld and cut materials for collision repair.

Descriptors:

- 25.4.1 Identify weldable and non-weldable materials used in collision repair [HP-I].
- 25.4.2 Weld and cut high-strength steel and other steels [HP-I].
- 25.4.3 Weld and cut aluminum [HP-G].
- 25.4.4 Determine the correct GMAW (MIG) welder type, electrode, wire type, diameter and gas to be used in a specific welding situation [HP-I].
- 25.4.5 Set up and adjust the GMAW (MIG) welder to “tune” for proper electrode stick-out, voltage, polarity, flow rate and wire-feed speed required for the material being welded [HP-I].
- 25.4.6 Store, handle and install high-pressure gas cylinders [HP-I].
- 25.4.7 Determine work clamp (ground) location and attach [HP-I].
- 25.4.8 Use the proper angle of the gun to the joint and direction of gun travel for the type of weld being made in the flat, horizontal, vertical and overhead positions [HP-I].
- 25.4.9 Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations [HP-I].
- 25.4.10 Protect computers and other electronic control modules during welding procedures [HP-I].
- 25.4.11 Clean and prepare the metal to be welded, assure good metal fit-up, apply weld-through primer if necessary and clamp as required [HP-I].
- 25.4.12 Determine joint type (e.g., butt weld with backing, lap) for weld being made [HP-I].
- 25.4.13 Determine the type of weld (e.g., continuous, butt weld with backing, plug) for each specific welding operation [HP-I].
- 25.4.14 Perform the following welds: continuous, stitch, tack, plug, butt weld with and without backing and fillet weld [HP-I].
- 25.4.15 Perform visual and destructive tests on each weld type [HP-I].
- 25.4.16 Identify the causes of various welding defects; make necessary adjustments [HP-I].
- 25.4.17 Identify the cause of contact tip burn-back and failure of wire to feed; make necessary adjustments [HP-I].
- 25.4.18 Identify cutting processes for different materials and locations; perform cutting operations [HP-I].
- 25.4.19 Identify different methods of attaching structural components (e.g., squeeze type resistance spot welding [STRSW], riveting, structural adhesive, silicon, bronze) [HP-G].

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

- *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)
- *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

- *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)

Unit 26: Non-Structural Analysis and Damage Repair

Note: Throughout Unit 26, students are expected to learn and use vocabulary specific to the collision repair 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
	P	R

Competency 26.1: Organize repair preparation.

Descriptors:

- 26.1.1 Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan [HP-I].
- 26.1.2 Inspect, remove, store and replace exterior trim and moldings [HP-I].
- 26.1.3 Inspect, remove, store and replace interior trim and components [HP-I].
- 26.1.4 Inspect, remove, store and replace non-structural body panels and components that may interfere with or be damaged during repair [HP-I].
- 26.1.5 Inspect, remove, store and replace all vehicle mechanical and electrical components that may interfere with or be damaged during repair [HP-G].
- 26.1.6 Protect panels, glass and parts adjacent to the repair area [HP-I].
- 26.1.7 Soap and water wash entire vehicle; use appropriate cleaner to remove contaminants from those areas to be repaired [HP-I].
- 26.1.8 Remove corrosion protection, under-coatings, sealers and other protective coatings necessary to perform repairs [HP-I].
- 26.1.9 Inspect, remove and replace repairable plastics and other components that are recommended for off-vehicle repair [HP-I].

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 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 26.2: Perform outer body panel repairs, replacements and adjustments.

Descriptors:

- 26.2.1 Determine the extent of direct and indirect damage and the direction of impact; develop and document a repair plan [HP-I].
- 26.2.2 Inspect, remove and replace bolted, bonded and welded steel panel or panel assemblies [HP-I].
- 26.2.3 Determine the extent of damage to aluminum body panels; repair or replace [HP-G].
- 26.2.4 Inspect, remove, replace and align hood, hood hinges and hood latch [HP-I].
- 26.2.5 Inspect, remove, replace and align deck lid, lid hinges and lid latch [HP-I].
- 26.2.6 Inspect, remove, replace and align doors, tailgates, hatches, lift gates, latches, hinges and related hardware [HP-I].
- 26.2.7 Inspect, remove, replace and align bumper bars, covers, reinforcement, guards, isolators and mounting hardware [HP-I].
- 26.2.8 Inspect, remove, replace and align front fenders, headers and other panels [HP-I].
- 26.2.9 Straighten and rough-out contours of damaged panels to a suitable condition for body filling or metal finishing using power tools, hand tools and weld-on pull attachments [HP-I].
- 26.2.10 Weld damaged or torn steel body panels; repair broken welds [HP-I].
- 26.2.11 Restore corrosion protection [HP-I].
- 26.2.12 Replace door skins [HP-G].
- 26.2.13 Restore sound deadeners and foam materials [HP-I].
- 26.2.14 Perform panel bonding [HP-G].
- 26.2.15 Diagnose and repair water leaks, dust leaks and wind noise [HP-G].

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

- *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)
- *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)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 26.3: Perform metal finishing and body filling.

Descriptors:

- 26.3.1 Remove paint from the damaged area of a body panel [HP-I].
- 26.3.2 Locate and reduce surface irregularities on a damaged body panel [HP-I].
- 26.3.3 Demonstrate hammer and dolly techniques [HP-I].
- 26.3.4 Heat shrink stretched panel areas to proper contour [HP-I].
- 26.3.5 Cold shrink stretched panel areas to proper contour [HP-I].
- 26.3.6 Mix body filler [HP-I].
- 26.3.7 Apply body filler; shape during curing [HP-I].
- 26.3.8 Rough sand cured body filler to contour; finish sand [HP-I].
- 26.3.9 Determine the proper metal finishing techniques for aluminum [HP-G].
- 26.3.10 Determine proper application of body filler to aluminum [HP-G].

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 26.4: Repair moveable glass and hardware.

Descriptors:

- 26.4.1 Inspect, adjust, repair or replace window regulators, run channels, glass, power mechanisms and related controls [HP-I].
- 26.4.2 Diagnose and repair water leaks, dust leaks and wind noises; inspect, repair and replace weather-stripping [HP-G].
- 26.4.3 Inspect, repair or replace and adjust removable, manual or power-operated roof panel and hinges, latches, guides, handles, retainer and controls for sunroofs [HP-G].
- 26.4.4 Inspect, remove, reinstall and align convertible top and related mechanisms [HP-G].

BIL: Essential

EDU:	12	AD
	P	R

Competency 26.5: Perform metal welding and cutting.

Descriptors:

- 26.5.1 Identify weldable and non-weldable materials used in collision repair [HP-I].
- 26.5.2 Weld and cut high-strength steel and other steels [HP-I].
- 26.5.3 Weld and cut aluminum [HP-G].
- 26.5.4 Determine the correct GMAW (MIG) welder type, electrode, wire type, diameter and gas to be used in a specific welding situation [HP-I].
- 26.5.5 Set up and adjust the GMAW (MIG) welder to “tune” for proper electrode stick-out, voltage, polarity, flow rate and wire-feed speed required for the material being welded [HP-I].
- 26.5.6 Store, handle and install high-pressure gas cylinders [HP-I].
- 26.5.7 Determine work clamp (ground) location and attach [HP-I].
- 26.5.8 Use the proper angle of the gun to the joint and direction of gun travel for the type of weld being made in the flat, horizontal, vertical and overhead positions [HP-I].
- 26.5.9 Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations [HP-I].
- 26.5.10 Protect computers and other electronic control modules during welding procedures [HP-I].
- 26.5.11 Clean and prepare the metal to be welded, assure good metal fit-up, apply weld-through primer if necessary, and clamp as required [HP-I].
- 26.5.12 Determine the joint type (e.g., butt weld with backing, lap) for weld being made [HP-I].
- 26.5.13 Determine the type of weld (e.g., continuous, butt weld with backing, plug) for each specific welding operation [HP-I].
- 26.5.14 Perform the following welds: continuous, stitch, tack, plug, butt weld with and without backing, and fillet [HP-I].

- 26.5.15 Perform visual and destructive tests on each weld type [HP-I].
- 26.5.16 Identify the causes of various welding defects; make necessary adjustments [HP-I].
- 26.5.17 Identify the cause of contact tip burn-back and failure of wire to feed; make necessary adjustments [HP-I].
- 26.5.18 Identify cutting process for different materials and locations; perform cutting operation [HP-I].
- 26.5.19 Identify different methods of attaching non-structural components (squeeze type resistant spot welds (STRSW), riveting, non-structural adhesive, silicon bronze, etc.) [HP-G].

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)
- *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

- *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)
- *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 26.6: Repair plastics and adhesives.

Descriptors:

- 26.6.1 Identify types of plastics and determine their repairability [HP-I].
- 26.6.2 Identify types of plastic repair procedures; clean and prepare the surface of plastic parts [HP-I].
- 26.6.3 Replace or repair rigid, semi-rigid and flexible plastic panels [HP-G].
- 26.6.4 Remove or repair damaged areas from rigid exterior composite panels [HP-G].
- 26.6.5 Replace bonded rigid exterior composite body panels; straighten or align panel supports [HP-G].

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

Unit 27: Mechanical and Electrical Components

Note: Throughout Unit 27, students are expected to learn and use vocabulary specific to the collision repair 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 27.1: Inspect, diagnose and repair suspension and steering.

Descriptors:

- 27.1.1 Identify one-time use fasteners [HP-I].
- 27.1.2 Remove, replace, inspect or adjust power steering pump, pulleys, belts, hoses, fittings and pump mounts [HP-G].
- 27.1.3 Remove and replace power steering gear (non-rack and pinion type) [HP-G].
- 27.1.4 Remove and replace power rack and pinion steering gear; inspect and replace mounting bushings, tie rod ends, bellow boots and brackets; ensure proper mounting location [HP-G].
- 27.1.5 Inspect and adjust (where applicable) steering linkage geometry (attitude and parallelism) [HP-G].
- 27.1.6 Inspect and replace pitman arm [HP-G].
- 27.1.7 Inspect and replace relay (center link/intermediate) rod [HP-G].
- 27.1.8 Inspect, remove and replace idler arm and mountings [HP-G].
- 27.1.9 Inspect, remove and replace tie rod sleeves, clamps and tie rod ends [HP-G].
- 27.1.10 Inspect, remove and replace steering linkage damper [HP-G].
- 27.1.11 Inspect, remove and replace upper and lower control arms [HP-G].
- 27.1.12 Inspect, remove and replace upper and lower control arm bushings, shafts and rebound bumpers [HP-G].
- 27.1.13 Inspect, remove and replace upper and lower ball joints [HP-G].
- 27.1.14 Inspect, remove and replace steering knuckle/spindle/hub assemblies (including bearings, races, seals, etc.) [HP-G].
- 27.1.15 Inspect, remove and replace front suspension coil springs and spring insulators (silencers) [HP-G].
- 27.1.16 Inspect, remove, replace and adjust suspension system torsion bars and inspect mounts [HP-G].
- 27.1.17 Inspect, remove and replace stabilizer bar bushings, brackets and links [HP-G].
- 27.1.18 Inspect, remove and replace MacPherson strut cartridge or assembly, upper bearing and mount [HP-G].
- 27.1.19 Inspect, remove and replace rear suspension system transverse links, control arms, stabilizer bars, bushings and mounts [HP-G].
- 27.1.20 Inspect, remove and replace suspension system leaf spring(s), leaf spring insulators (silencers), shackles, brackets, bushings and mounts [HP-G].

- 27.1.21 Inspect axle assembly for damage and misalignment [HP-G].
- 27.1.22 Inspect, remove and replace shock absorbers [HP-G].
- 27.1.23 Diagnose, inspect, adjust and repair or replace active suspension systems and associated lines and fittings [HP-G].
- 27.1.24 Measure vehicle ride height and determine needed repairs [HP-I].
- 27.1.25 Inspect, remove, replace and align front and rear frame (cradles/sub) [HP-G].
- 27.1.26 Diagnose steering column damage, looseness and binding problems, including tilt mechanisms, and determine needed repairs [HP-G].
- 27.1.27 Inspect, remove and replace steering shaft U-joint(s), flexible coupling(s), collapsible columns and steering wheels [HP-G].
- 27.1.28 Diagnose manual and power steering gear (non-rack and pinion type) noises, binding, uneven turning effort, looseness, hard steering, and fluid leakage problems; determine needed repairs [HP-G].
- 27.1.29 Diagnose power rack and pinion steering gear noises, vibration, looseness, hard steering, and fluid leakage problems, and ensure proper mounting location; determine needed repairs [HP-G].
- 27.1.30 Diagnose non-MacPherson front and rear suspension system noises and body sway problems; determine needed repairs [HP-G].
- 27.1.31 Diagnose MacPherson strut suspension system noises and body sway problems; determine needed repairs [HP-G].
- 27.1.32 Diagnose vehicle wandering, pulling, hard steering, bump steering, memory steering, torque steering and steering return problems; determine needed repairs [HP-G].
- 27.1.33 Adjust front and rear wheel camber on suspension systems with camber adjustments [HP-I].
- 27.1.34 Check front and rear wheel camber on adjustable and non-adjustable suspension systems; determine needed repairs [HP-I].
- 27.1.35 Adjust caster on suspension systems with caster adjustments [HP-I].
- 27.1.36 Check caster on adjustable and non-adjustable suspension systems; determine needed repairs [HP-I].
- 27.1.37 Check and adjust wheel toe, including centering steering wheel; determine needed adjustment or repair [HP-I].
- 27.1.38 Identify toe-out-on-turns (turning radius) related problems, and determine needed repairs [HP-I].
- 27.1.39 Identify steering axis inclination (SAI), included angle, and king pin inclination (KPI) related problems; determine needed repairs [HP-I].
- 27.1.40 Identify thrust angle related problems; determine needed repairs [HP-I].
- 27.1.41 Check for front wheel setback; determine needed repairs [HP-I].
- 27.1.42 Diagnose tire wear patterns; determine needed repairs [HP-I].
- 27.1.43 Inspect tires, identify direction of rotation and location; check and adjust air pressure [HP-I].
- 27.1.44 Diagnose wheel and tire vibration, shimmy, and tramp (wheel hop) problems; determine needed repairs [HP-G].
- 27.1.45 Measure wheel, tire, axle and hub run-out; determine needed repairs [HP-I].
- 27.1.46 Diagnose tire pull (lead) problems; determine corrective actions [HP-G].
- 27.1.47 Reinstall wheels and torque lug nuts [HP-I].

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

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

Descriptors:

- 27.2.1 Check voltages in electrical wiring circuits with a digital multimeter (DMM) [HP-I].
- 27.2.2 Check for voltage drop and/or current flow in electrical wiring circuits and components with a DMM [HP-I].
- 27.2.3 Repair electrical circuits, wiring and connectors [HP-I].
- 27.2.4 Inspect, test and replace fusible links, circuit breakers and fuses [HP-I].
- 27.2.5 Perform battery state-of-charge test; determine needed service [HP-I].
- 27.2.6 Inspect, clean and replace battery [HP-I].
- 27.2.7 Dispose of batteries and battery acid according to local, state and federal requirements [HP-G].

- 27.2.8 Perform slow and fast battery charge [HP-I].
- 27.2.9 Identify programmable electrical and electronic components, and record data for reprogramming before disconnecting the battery [HP-I].
- 27.2.10 Inspect, clean, repair or replace battery cables, connectors and clamps [HP-I].
- 27.2.11 Inspect alignment, adjust, remove and replace alternator (generator), drive belts, pulleys and fans [HP-I].
- 27.2.12 Check operation of exterior lighting; determine needed repairs [HP-I].
- 27.2.13 Aim headlamp assemblies (e.g., fog, driving lamps) and determine needed repairs [HP-I].
- 27.2.14 Inspect, test, repair or replace switches, relays, bulbs, sockets, connectors and wires of interior and exterior light circuits [HP-I].
- 27.2.15 Remove and replace horn(s); check operation [HP-I].
- 27.2.16 Check operation of wiper/washer systems; determine needed repairs [HP-I].
- 27.2.17 Check operation of power side and tailgate window; determine needed repairs [HP-I].
- 27.2.18 Inspect, remove and replace power seat, motors, linkages, cables, etc. [HP-G].
- 27.2.19 Inspect, remove and replace components of electric door and hatch/trunk lock [HP-G].
- 27.2.20 Inspect, remove and replace components of keyless locking devices and alarm systems [HP-G].
- 27.2.21 Inspect, remove and replace components of electrical sunroof and convertible top [HP-G].
- 27.2.22 Check the operation of electrically heated mirrors, windshields, backlights and panels, and repair as necessary [HP-I].
- 27.2.23 Inspect, remove and replace components of power antenna circuits [HP-I].
- 27.2.24 Demonstrate the proper self-grounding procedures for handling electronic components [HP-I].
- 27.2.25 Check for module communication errors using a scan tool [HP-G].
- 27.2.26 Use wiring diagrams and diagnostic flow charts during diagnosis of electrical circuit problems [HP-G].
- 27.2.27 Demonstrate safe disarming techniques of high voltage systems on hybrid vehicles [HP-G].

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

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

- *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)
- *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 27.3: Diagnosis and perform repairs to brake systems.

Descriptors:

- 27.3.1 Inspect brake lines and fittings for leaks, dents, kinks, rust, cracks or wear; tighten loose fittings and supports; replace brake lines (double flare and International Standards Organization [ISO] types), fittings and supports [HP-I].
- 27.3.2 Inspect flexible brake hoses for leaks, kinks, cracks, bulging or wear; remove and replace hoses; and tighten loose fittings and supports [HP-I].
- 27.3.3 Identify, handle, store and install appropriate brake fluids, and dispose in accordance with federal, state and local regulations [HP-G].
- 27.3.4 Bleed (manual, pressure, vacuum or surge) hydraulic brake system [HP-I].
- 27.3.5 Pressure test brake hydraulic system and determine needed repair [HP-G].
- 27.3.6 Adjust brake shoes; remove and reinstall brake drums or drum/hub assemblies and wheel bearings [HP-I].
- 27.3.7 Reinstall wheel and torque lug nuts [HP-I].
- 27.3.8 Remove and reinstall caliper assembly [HP-I].
- 27.3.9 Clean and inspect caliper mountings for wear and damage [HP-I].
- 27.3.10 Check parking brake system operation [HP-I].
- 27.3.11 Identify and replace antilock brake system (ABS) wheel speed sensor components [HP-G].
- 27.3.12 Depressurize ABS hydraulic or electronic system [HP-G].
- 27.3.13 Identify the proper procedures for handling brake dust [HP-G].
- 27.3.14 Check for bent or damaged brake system components [HP-G].

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

- *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 27.4: Diagnose and repair heating and air conditioning (A/C) systems.

Descriptors:

- 27.4.1 Identify and comply with environmental concerns relating to refrigerants and coolants [HP-G].
- 27.4.2 Maintain and verify the correct operation of certified refrigerant recovery and recharging equipment [HP-G].
- 27.4.3 Locate and identify A/C system service ports [HP-I].
- 27.4.4 Identify and recover refrigerant from A/C systems [HP-G].
- 27.4.5 Recycle refrigerant in accordance with EPA regulations [HP-G].
- 27.4.6 Identify, label and store refrigerant [HP-G].
- 27.4.7 Test recycled refrigerant for non-condensable gases [HP-G].
- 27.4.8 Evacuate A/C system and check for leaks [HP-G].
- 27.4.9 Recharge A/C system with refrigerant and perform leak test [HP-G].
- 27.4.10 Identify oil type and maintain the correct amount in A/C system [HP-G].
- 27.4.11 Inspect, adjust and replace A/C compressor drive belts; check pulley alignment [HP-G].
- 27.4.12 Remove and replace A/C compressor; inspect, repair or replace A/C compressor mount [HP-G].
- 27.4.13 Inspect and repair or replace A/C system mufflers, hoses, lines, fittings, orifice tube, expansion valve and seals [HP-G].
- 27.4.14 Inspect, test and replace A/C system condenser and mounts [HP-G].
- 27.4.15 Inspect and replace receiver/drier or accumulator/drier [HP-G].
- 27.4.16 Inspect and repair A/C component wiring [HP-G].

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 how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)
- *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 27.5: Diagnose and repair cooling systems.

Descriptors:

- 27.5.1 Check engine cooling and heater system hoses and belts; determine needed repairs [HP-I].
- 27.5.2 Inspect, test, remove and replace radiator, pressure cap, coolant recovery system and water pump [HP-G].
- 27.5.3 Recover, refill and bleed system with proper coolant; check level of protection; leak test system and dispose of materials in accordance with EPA specifications [HP-I].
- 27.5.4 Remove and replace fan (both electrical and mechanical), fan pulley, fan clutch and fan shroud [HP-G].
- 27.5.5 Inspect, remove and replace auxiliary oil/fluid coolers; check oil levels [HP-G].
- 27.5.6 Inspect, remove and replace electric fan sensors; check operation [HP-G].

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 how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)
- *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 27.6: Diagnose and repair drive train.

Descriptors:

- 27.6.1 Remove, replace and adjust shift or clutch linkage as required [HP-G].
- 27.6.2 Remove, replace and adjust cables or linkages for throttle valve (TV), kick-down and accelerator pedal [HP-G].
- 27.6.3 Remove and replace electronic sensors, wires and connectors [HP-G].
- 27.6.4 Remove and replace power train assembly; inspect, replace and align power train mounts [HP-G].
- 27.6.5 Remove and replace drive axle assembly [HP-G].
- 27.6.6 Inspect, remove and replace half shafts and axle constant velocity (CV) joints [HP-G].
- 27.6.7 Inspect, remove and replace drive shafts and universal joints [HP-G].

Correlated Mathematics Academic Content Benchmarks

- *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

EDU:	12	AD
	I	P

Competency 27.7: Diagnose and repair fuel, intake and exhaust systems.

Descriptors:

- 27.7.1 Inspect, remove and replace exhaust pipes, mufflers, converters, resonators, tail pipes and heat shields [HP-G].
- 27.7.2 Inspect, remove and replace fuel tank, fuel tank filter, fuel cap, fuel filler hose and inertia switch; inspect and replace fuel lines and hoses; check fuel for contaminants [HP-G].
- 27.7.3 Inspect, remove and replace engine components of air intake systems [HP-G].
- 27.7.4 Inspect, remove and replace canister, filter and vent, and purge lines of fuel vapor Automotive EVAPorative System (EVAP) control systems [HP-G].

Correlated Mathematics Academic Content Benchmarks

- *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 27.8: Diagnose and repair restraint systems.

Descriptors:

- 27.8.1 Identify and perform vehicle manufacturer’s recommended procedures for inspecting or replacing restraint systems and components [HP-I].
- 27.8.2 Inspect, remove and replace seatbelt and shoulder harness assembly and components [HP-G].
- 27.8.3 Inspect restrain system mounting areas for damage; repair as needed [HP-G].
- 27.8.4 Verify proper operation of seatbelt [HP-G].
- 27.8.5 Deactivate and reactivate Supplemental Restraint System (SRS) [HP-G].
- 27.8.6 Inspect, remove and replace Supplemental Restraint System (SRS) sensors and wiring; ensure sensor orientation [HP-G].
- 27.8.7 Verify that Supplemental Restraint System (SRS) is operational [HP-I].
- 27.8.8 Inspect, remove, replace and dispose of deployed and non-deployed airbag(s) and pretensioners [HP-G].
- 27.8.9 Use Diagnostic Trouble Codes (DTC) to diagnose and repair the Supplemental Restraint System (SRS) [HP-G].

Correlated Mathematics Academic Content Benchmarks

- *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 28: Painting and Refinishing

BIL: Essential

EDU:	12	AD
	P	R

Competency 28.1: Demonstrate safety precautions.

Descriptors:

- 28.1.1 Identify and follow necessary precautions with hazardous operations and materials, according to federal, state and local regulations [HP-I].
- 28.1.2 Identify safety and personal health hazards according to Occupational Safety and Health Administration (OSHA) guidelines and the “Right to Know” law [HP-I].
- 28.1.3 Inspect spray environment to ensure compliance with federal, state and local regulations, and for safety and cleanliness hazards [HP-I].
- 28.1.4 Select and use the National Industrial Occupational Safety & Health (NIOSH) approved personal sanding respirator; inspect its condition and ensure fit and operation; perform proper maintenance in accordance with OSHA regulation 1910.134 and applicable state and local regulations [HP-I].
- 28.1.5 Select and use the NIOSH approved (Fresh Air Make-up System) personal painting/ refinishing respirator system; perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulations [HP-I].
- 28.1.6 Select and use the proper personal safety equipment for surface preparation, spray gun and related equipment operation, paint mixing, matching and application, paint defects, and detailing (e.g., gloves, suits, hoods, eye and ear protection) [HP-I].

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 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 28.2: Prepare surface for refinishing.

Descriptors:

- 28.2.1 Inspect, remove, store and replace exterior trim and components necessary for proper surface preparation [HP-I].
- 28.2.2 Soap and water wash entire vehicle; use appropriate cleaner to remove contaminants [HP-I].
- 28.2.3 Inspect and identify substrate, type of finish, surface condition and film thickness; develop and document a plan for refinishing using a total product system [HP-I].
- 28.2.4 Remove paint finish [HP-I].
- 28.2.5 Dry or wet sand areas to be refinished [HP-I].
- 28.2.6 Featheredge damaged areas to be refinished [HP-I].
- 28.2.7 Apply suitable metal treatment or primer in accordance with total product systems [HP-I].
- 28.2.8 Mask and protect other areas that will not be refinished [HP-I].
- 28.2.9 Mix primer, primer-surfacer or primer-sealer [HP-I].
- 28.2.10 Apply primer onto surface of repaired area [HP-I].
- 28.2.11 Apply two-component finishing filler to minor surface imperfections [HP-I].
- 28.2.12 Dry or wet sand area to which primer-surfacer has been applied [HP-I].
- 28.2.13 Dry sand area to which two-component finishing filler has been applied [HP-I].
- 28.2.14 Remove dust from area to be refinished, including cracks or moldings of adjacent areas [HP-I].
- 28.2.15 Clean area to be refinished using a final cleaning solution [HP-I].
- 28.2.16 With a tack rag, remove any dust or lint particles from the area to be refinished [HP-I].
- 28.2.17 Apply a suitable sealer to the area being refinished when sealing is needed or desirable [HP-I].
- 28.2.18 Scuff sand to remove nibs or imperfections from a sealer [HP-I].
- 28.2.19 Apply stone chip resistant coating [HP-G].
- 28.2.20 Restore corrosion-resistant coatings, caulking, and seam sealers to repaired areas [HP-I].
- 28.2.21 Prepare adjacent panels for blending [HP-I].
- 28.2.22 Identify the types of rigid, semi-rigid or flexible plastic parts to be refinished; determine the materials, preparation and refinishing procedures [HP-I].
- 28.2.23 Identify aluminum parts to be refinished; determine the materials, preparation and refinishing procedures [HP-G].

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

- *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)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 28.3: **Properly operate spray gun and related equipment.**

Descriptors:

- 28.3.1 Inspect, clean and determine the condition of spray guns and related equipment, including air hoses, regulators, air lines, air source and spray environment [HP-I].
- 28.3.2 Check and adjust spray gun operation for high volume, low pressure (HVLP) or low volume, low pressure (LVLP) guns [HP-I].
- 28.3.3 Set-up (fluid needle, nozzle and cap), adjust and test spray gun using fluid, air and pattern control valves [HP-I].

Correlated Mathematics Academic Content Benchmarks

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

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 28.4: **Mix, match and apply paint.**

Descriptors:

- 28.4.1 Determine the type and color of paint already on the vehicle by manufacturer's vehicle information label [HP-I].
- 28.4.2 Shake, stir, reduce, catalyze/activate and strain paint [HP-I].
- 28.4.3 Apply finish using appropriate spray techniques (gun arc, gun angle, gun distance, gun speed and spray pattern overlap) for the finish being applied [HP-I].
- 28.4.4 Apply selected product on test and letdown panel; check for color match [HP-I].
- 28.4.5 Apply a single stage topcoat [HP-I].
- 28.4.6 Apply basecoat/clearcoat for panel blending or partial refinishing [HP-I].
- 28.4.7 Apply basecoat/clearcoat for overall refinishing [HP-G].
- 28.4.8 Denib, buff and polish finishes where necessary [HP-I].
- 28.4.9 Refinish rigid, semi-rigid and flexible plastic parts [HP-G].
- 28.4.10 Apply multi-stage coats for panel blending or overall refinishing [HP-G].
- 28.4.11 Identify and mix paint using a formula [HP-G].
- 28.4.12 Identify poor hiding colors; determine necessary action [HP-G].
- 28.4.13 Tint color using a formula to achieve a blendable match [HP-G].
- 28.4.14 Identify an alternative color formula to achieve a blendable match [HP-G].

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, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 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)
- *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 28.5: Identify and correct paint defects.

Descriptors:

- 28.5.1 Identify blistering (raising of the paint surface); determine the cause(s) and correct the conditions [HP-G].
- 28.5.2 Identify blushing (milky or hazy formation); determine the cause(s) and correct the condition [HP-G].
- 28.5.3 Identify a dry spray appearance in the paint surface; determine the cause(s) and correct the condition [HP-G].
- 28.5.4 Identify the presence of fish-eyes (crater-like openings) in the finish; determine the cause(s) and correct the condition [HP-G].
- 28.5.5 Identify lifting; determine the cause(s) and correct the conditions [HP-G].
- 28.5.6 Identify clouding (mottling and streaking in metallic finishes); determine the cause(s) and correct the condition [HP-G].
- 28.5.7 Identify orange peel; determine the cause(s) and correct the condition [HP-I].
- 28.5.8 Identify overspray; determine the cause(s) and correct the condition [HP-G].
- 28.5.9 Identify solvent popping in a freshly painted surface; determine the cause(s) and correct the condition [HP-G].
- 28.5.10 Identify sags and runs in paint surface; determine the cause(s) and correct the condition [HP-G].
- 28.5.11 Identify sanding marks (sand-scratch swelling); determine the cause(s) and correct the condition [HP-G].
- 28.5.12 Identify contour mapping (shrinking and splitting) while finish is drying; determine the cause(s) and correct the condition [HP-G].
- 28.5.13 Identify color difference (off-shade); determine the cause(s) and correct the condition [HP-G].
- 28.5.14 Identify tape tracking; determine the cause(s) and correct the condition [HP-G].

28.5.15	Identify low gloss condition; determine the cause(s) and correct the condition [HP-G].
28.5.16	Identify poor adhesion; determine the cause(s) and correct the conditions [HP-G].
28.5.17	Identify paint cracking (crowsfeet or line-checking, micro-checking, etc.); determine the cause(s) and correct the condition [HP-G].
28.5.18	Identify corrosion; determine the cause(s) and correct the condition [HP-G].
28.5.19	Identify dirt or dust in the paint surface; determine the cause(s) and correct the condition [HP-I].
28.5.20	Identify water spotting; determine the cause(s) and correct the condition [HP-G].
28.5.21	Identify finish damage caused by bird droppings, tree sap, and other natural causes; correct the condition [HP-G].
28.5.22	Identify finish damage caused by airborne contaminants (acids, soot, rail dust, and other industrial-related causes); correct the condition [HP-G].
28.5.23	Identify die-back conditions (dulling of the paint film showing haziness); determine the cause(s) and correct the conditions [HP-G].
28.5.24	Identify chalking (oxidation); determine the cause(s) and correct the condition [HP-G].
28.5.25	Identify bleed-through (staining); determine the cause(s) and correct the condition [HP-G].
28.5.26	Identify pin-holing; determine the cause(s) and correct the condition [HP-G].
28.5.27	Identify buffing-related imperfections (swirl marks, wheel burns); correct the condition [HP-G].
28.5.28	Identify pigment flotation (color change through film build); determine the cause(s) and correct the condition [HP-G].
28.5.29	Measure mil thickness [HP-I].

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)*

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

Competency 28.6: Perform final detailing.

Descriptors:

- 28.6.1 Apply decals, transfers, tapes, wood-grains and/or pinstripes (painted and taped) [HP-G].
- 28.6.2 Buff and polish finish to remove defects as required [HP-I].
- 28.6.3 Clean interior, exterior and glass [HP-I].
- 28.6.4 Clean body openings (e.g., door jambs and edges) [HP-I].
- 28.6.5 Remove overspray [HP-I].

**MEDIUM AND HEAVY
TRANSPORTATION EQUIPMENT
TECHNOLOGY**

UNITS 29 - 40

Medium and Heavy Transportation Equipment Technology

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 29: Orientation to the Medium and Heavy Transportation Industry

BIL: Essential

EDU:	12	AD
	I	P

Competency 29.1: Analyze the scope, trends and issues in the medium and heavy transportation industry.

Descriptors:

- 29.1.1 Present an overview of the medium and heavy transportation industry.
- 29.1.2 Identify trends and issues that affect the medium and heavy transportation industry.
- 29.1.3 Identify the professional and/or trade associations related to the medium and heavy transportation industry.
- 29.1.4 Identify areas of specialization and related occupations within the medium and heavy transportation industry.
- 29.1.5 Identify the employment opportunities in the medium and heavy transportation 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)*

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)*
- *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
	I	P

Competency 29.2: Determine the skills needed to work in the medium and heavy transportation industry.

Descriptors:

- 29.2.1 Match medium and heavy transportation occupational job titles with qualifications and responsibilities.
- 29.2.2 Identify the education, training and certification required to work in the various medium and heavy transportation careers.
- 29.2.3 Describe the kinds of work techniques, processes and procedures a typical medium and heavy transportation worker might be called upon to perform.

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 30: Tools and Equipment

BIL: Essential

EDU:	12	AD
	P	R

Competency 30.1: Identify basic tools and equipment appropriate to the medium and heavy transportation industry.

Descriptors:

- 30.1.1 Identify the various types of tools and equipment applicable to a specified transportation application.
- 30.1.2 Describe the primary functions of various types of hand and power tools.
- 30.1.3 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

EDU:	12	AD
	P	R

Competency 30.2: Demonstrate the appropriate use of basic hand tools to complete work functions.

Descriptors:

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

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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 30.3: Operate power tools and stationary equipment.

Descriptors:

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

BIL: Essential

EDU:	12	AD
	P	R

Competency 30.4: Maintain hand and power tools appropriate to the medium and heavy transportation industry.

Descriptors:

- 30.4.1 Conduct routine inspections of hand tools and power equipment.
- 30.4.2 Troubleshoot maintenance problems in accordance with established procedures.
- 30.4.3 Perform preventive maintenance in accordance with guidelines specified by the manufacturer and/or outside authorities with jurisdiction (e.g., OSHA).
- 30.4.4 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 30.5: Use appropriate personal protective equipment (PPE)

Descriptors:

- 30.5.1 Identify the appropriate personal protective equipment (PPE) to wear with specific transportation tasks.
- 30.5.2 Discuss various conditions that workers encounter, and match the appropriate PPE to each situation.
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 31: Medium and Heavy Transportation Basics

Note: Throughout Unit 31, students are expected to learn and use vocabulary specific to the medium and heavy transportation equipment technology 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 31.1: Perform basic mechanical skills.

Descriptors:

- 31.1.1 Identify types, sizes and strengths of various fasteners and fittings.
- 31.1.2 Drill holes.
- 31.1.3 Perform tap and die techniques.
- 31.1.4 Sharpen drill bits and chisels.
- 31.1.5 Extract broken screws.
- 31.1.6 Repair damaged threads.
- 31.1.7 Demonstrate flaring techniques (single and double).
- 31.1.8 Assemble basic hydraulic and pneumatic hose and tubing.
- 31.1.9 Demonstrate soldering techniques.
- 31.1.10 Demonstrate wire connection techniques, including soldering and crimping.
- 31.1.11 Perform various torque procedures of fasteners.

Correlated Mathematics Academic Content Benchmarks

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

EDU:	12	AD
	I	P

Competency 31.2: Perform basic welding and cutting tasks.

Descriptors:

- 31.2.1 Wear safety gloves, eye protection and leathers.
- 31.2.2 Employ appropriate safety procedures for welding and oxyacetylene welding.
- 31.2.3 Solder and braze using oxyacetylene equipment.
- 31.2.4 Cut using oxyacetylene equipment.
- 31.2.5 Weld using arc welding equipment.
- 31.2.6 Weld using MIG equipment.
- 31.2.7 Identify emerging welding techniques.

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

Correlated Science Academic Content Benchmarks

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

Unit 32: Diesel Engines

Note: Throughout Unit 32, students are expected to learn and use vocabulary specific to the medium and heavy transportation equipment technology 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 32.1: Perform general engine diagnosis and determine needed action.

Descriptors:

- 32.1.1 Inspect fuel, oil and coolant levels, condition and consumption [P-1].
- 32.1.2 Diagnose causes of engine fuel, oil, coolant, air and other leaks [P-1].
- 32.1.3 Interpret engine noises [P-2].
- 32.1.4 Observe engine exhaust smoke color and quantity [P-1].
- 32.1.5 Perform air intake system restriction and leakage tests [P-1].
- 32.1.6 Perform intake manifold pressure (boost) test [P-1].
- 32.1.7 Perform exhaust back pressure test [P-2].
- 32.1.8 Perform crankcase pressure test [P-1].
- 32.1.9 Diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems [P-1].
- 32.1.10 Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration and shutdown problems [P-1].
- 32.1.11 Diagnose engine vibration problems [P-2].
- 32.1.12 Check, record and clear electronic diagnostic (fault) codes; monitor electronic data [P-1].
- 32.1.13 Perform cylinder compression test [P-3].

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**

EDU:	12	AD
	I	P

Competency 32.2: Diagnose and repair cylinder head and valve train.

Descriptors:

- 32.2.1 Remove, clean, inspect for visible damage and replace cylinder head(s) assembly [P-1].
- 32.2.2 Clean and inspect threaded holes, studs and bolts for serviceability; determine needed action [P-1].
- 32.2.3 Inspect cylinder head for cracks and damage; check mating surfaces for warpage; check condition of passages; inspect core, expansion and gallery plugs; determine needed action [P-1].
- 32.2.4 Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks and seals; determine needed action [P-3].
- 32.2.5 Measure valve head height relative to deck and valve face-to-seat contact; determine needed action [P-3].
- 32.2.6 Inspect injector sleeves and seals; measure injector tip or nozzle protrusion; perform needed action [P-3].
- 32.2.7 Inspect and adjust valve bridges (crossheads) and guides; perform needed action [P-2].
- 32.2.8 Reassemble cylinder head [P-3].
- 32.2.9 Inspect, measure and replace or reinstall overhead camshaft; measure and adjust end play and backlash [P-2].
- 32.2.10 Inspect pushrods, rocker arms, rocker arm shafts, electronic wiring harness and brackets for wear, bending, cracks, looseness and blocked oil passages [P-2].
- 32.2.11 Inspect cam followers; perform needed action [P-2].
- 32.2.12 Adjust valve clearance [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)
- *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 32.3: Diagnose and repair engine block.

Descriptors:

- 32.3.1 Remove, inspect, service and install pans, covers, vents, gaskets, seals and wear rings [P-1].
- 32.3.2 Disassemble, clean and inspect engine block for cracks and damage; measure mating surfaces for warpage; check condition of passages, core, expansion and gallery plugs; inspect threaded holes, studs, dowel pins and bolts for serviceability; determine needed action [P-3].
- 32.3.3 Inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed action [P-3].
- 32.3.4 Clean, inspect and measure cylinder walls or liners for wear and damage; determine needed action [P-2].
- 32.3.5 Replace or reinstall cylinder liners and seals; check and adjust liner height (protrusion) [P-2].
- 32.3.6 Inspect in-block camshaft bearings for wear and damage; determine needed action [P-3].
- 32.3.7 Inspect, measure and replace or reinstall in-block camshaft; measure and adjust end play [P-3].
- 32.3.8 Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action [P-2].
- 32.3.9 Inspect main bearings for wear patterns and damage; replace as needed; check bearing clearances; check and adjust crankshaft end play [P-2].
- 32.3.10 Inspect, install and time gear train; measure gear backlash; determine needed action [P-3].
- 32.3.11 Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers and bushings; perform needed action [P-2].
- 32.3.12 Determine piston-to-cylinder wall clearance; check ring-to-groove clearance and end gap; install rings on pistons [P-2].
- 32.3.13 Assemble pistons and connecting rods; install in block; install rod bearings and check clearances [P-2].
- 32.3.14 Check condition of piston cooling jets (nozzles); determine needed action [P-2].
- 32.3.15 Inspect and measure crankshaft vibration damper; determine needed action [P-2].
- 32.3.16 Install and align flywheel housing; inspect flywheel housing(s) to transmission housing and engine mating surfaces(s) and measure flywheel housing face and bore runout; determine needed action [P-3].
- 32.3.17 Inspect flywheel, flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed 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)
- *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**

EDU:	12	AD
	I	P

Competency 32.4: **Diagnose and repair lubrication system.**

Descriptors:

- 32.4.1 Test engine oil pressure, and check operation of pressure sensor, gauge and/or sending unit; determine needed action [P-1].
- 32.4.2 Check engine oil level, condition and consumption; determine needed action [P-1].
- 32.4.3 Inspect and measure oil pump, drives, inlet pipes and pick-up screens; determine needed action [P-3].
- 32.4.4 Inspect oil pressure regulator valve(s), bypass and pressure relief valve(s), oil thermostat and filters; determine needed action [P-3].
- 32.4.5 Inspect, clean and test oil cooler and components; determine needed action [P-3].
- 32.4.6 Inspect turbocharger lubrication system; determine needed action [P-2].
- 32.4.7 Determine proper lubricant, and 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)
- *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)
- *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 32.5: Diagnose and repair cooling system.

Descriptors:

- 32.5.1 Check engine coolant type, level, condition and consumption; determine needed action [P-1].
- 32.5.2 Test coolant temperature and check operation of temperature sensor, gauge, and/or sending unit; determine needed action [P-2].
- 32.5.3 Inspect and reinstall or replace pulleys, tensioners and drive belts; adjust drive belts and check alignment [P-1].
- 32.5.4 Inspect thermostat(s), bypasses, housing(s) and seals; replace as needed [P-2].
- 32.5.5 Test coolant for freeze protection and additive package concentration; adjust as needed [P-1].
- 32.5.6 Recover, flush and refill with recommended coolant and/or additive package; bleed cooling system [P-1].
- 32.5.7 Inspect coolant conditioner and filter assembly for leaks; inspect valves, lines and fittings; replace as needed [P-1].
- 32.5.8 Inspect water pump and hoses; replace as needed [P-1].
- 32.5.9 Inspect, clean and pressure test radiator, pressure cap, tank(s) and recovery systems; determine needed action [P-1].
- 32.5.10 Inspect thermostatic cooling fan system (hydraulic, pneumatic and electronic) and fan shroud; replace as needed [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)
- *Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 32.6: Diagnose and repair air induction and exhaust systems.

Descriptors:

- 32.6.1 Inspect turbocharger(s), wastegate and piping systems; determine needed action [P-2].
- 32.6.2 Check air induction system, including piping, hoses, clamps and mounting; check for air restrictions and leaks; service or replace air filter as needed [P-1].
- 32.6.3 Remove and reinstall turbocharger and wastegate assembly [P-2].
- 32.6.4 Inspect intake manifold, gaskets and connections; replace as needed [P-3].
- 32.6.5 Inspect, clean and test charge air cooler assemblies; replace as needed [P-2].
- 32.6.6 Inspect exhaust manifold, piping, mufflers, exhaust after-treatment device(s) and mounting hardware; repair or replace as needed [P-2].
- 32.6.7 Inspect and test preheater and inlet air heater or glow plug system and controls; perform needed action [P-2].
- 32.6.8 Inspect and test exhaust gas recirculation (EGR) system; determine action needed [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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 32.7: Diagnose and repair fuel system.

Descriptors:

- 32.7.1 Check fuel level, quality and consumption; determine needed action [P-1].
- 32.7.2 Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determine needed action [P-1].
- 32.7.3 Inspect, clean and test fuel transfer (lift) pump, pump drives, screens, fuel-water separators and indicators, filters, heaters, coolers, engine control module (ECM) cooling plates and mounting hardware; determine needed action [P-1].
- 32.7.4 Inspect and test low-pressure regulator systems, including check valves, pressure regulator valves and restrictive fittings; determine needed action [P-1].
- 32.7.5 Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump [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)

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 32.8: Diagnose and repair mechanical fuel injection.

Descriptors:

- 32.8.1 Perform on-engine inspections, tests and adjustments; check and adjust timing or replace and time a distributor- (rotary-) type injection pump; determine needed action [P-3].
- 32.8.2 Perform on-engine inspections, tests and adjustments; check and adjust timing or replace and time an in-line type injection pump; determine needed action [P-3].
- 32.8.3 Inspect and adjust throttle control linkage; determine needed action [P-3].
- 32.8.4 Inspect air-to-fuel ratio control systems; determine needed action [P-3].
- 32.8.5 Inspect, test and adjust engine fuel shutdown devices and controls; determine needed action [P-3].
- 32.8.6 Inspect high-pressure injection lines, hold downs, fittings and seals; replace as needed [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)
- *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 32.9: **Diagnose and repair electronic fuel management system.**

Descriptors:

- 32.9.1 Inspect and test power and ground circuits and connections; measure and interpret voltage, voltage drop, amperage and resistance readings using a Digital Multimeter (DMM); determine needed action [P-1].
- 32.9.2 Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools, including PC-based software and/or data scan tools; determine needed action [P-1].
- 32.9.3 Locate and use relevant service information, including diagnostic procedures, flowcharts and wiring diagrams [P-1].
- 32.9.4 Inspect and replace electrical connector terminals, seals and locks [P-1].
- 32.9.5 Inspect and test switches, sensors, controls, actuator components and circuits; adjust or replace as needed [P-1].
- 32.9.6 Use recommended electronic diagnostic tools, including PC-based software and/or data scan tools, access and change customer parameters [P-1].
- 32.9.7 Inspect, test and adjust electronic unit injectors (EUI); determine needed action [P-2-R].
- 32.9.8 Remove and install EUI and related components; recalibrate ECM (if applicable) [P-2-R].
- 32.9.9 Perform cylinder contribution test utilizing recommended electronic diagnostic tool [P-1].
- 32.9.10 Perform engine timing sensor calibration (if applicable) [P-3-O].
- 32.9.11 Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action [P-2-R].
- 32.9.12 Perform on-engine inspections and tests on hydraulic electronic unit injector high-pressure oil supply and control systems; determine needed action [P-2-R].
- 32.9.13 Perform on-engine inspections and tests on distributor-type injection pump electronic controls; determine needed action [P-2-O].
- 32.9.14 Perform on-engine inspections and tests on in-line type injection pump electronic controls; determine needed action [P-2-O].
- 32.9.15 Perform on-engine inspections and test on common rail type injection systems; determine needed action [P-3-R].

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 32.10: **Inspect and adjust engine brakes.**

Descriptors:

- 32.10.1 Inspect and adjust engine compression and exhaust brakes; determine needed action [P-2].
- 32.10.2 Inspect, test and adjust engine compression and exhaust brake control circuits, switches and solenoids; repair or replace as needed [P-3].
- 32.10.3 Inspect engine compression and exhaust brake housing, valves, seals, screens, lines and fittings; repair or replace as needed [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)
- *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 33: Drive Train

Note: Throughout Unit 33, students are expected to learn and use vocabulary specific to the medium and heavy transportation equipment technology 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 33.1: Diagnose and repair clutch.

Descriptors:

- 33.1.1 Diagnose clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging and chatter problems; determine needed action [P-1].
- 33.1.2 Inspect and adjust clutch linkage, cables, levers, brackets, bushings, pivots, springs and clutch safety switch, including push and pull-type assemblies; check pedal height and travel; perform needed action [P-1].
- 33.1.3 Inspect, adjust, repair or replace hydraulic clutch slave and master cylinders, lines and hoses; bleed system [P-2].
- 33.1.4 Inspect, adjust, lubricate or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts and seals [P-1].
- 33.1.5 Inspect, adjust and replace single-disc clutch pressure plate and clutch disc [P-2].
- 33.1.6 Inspect, adjust and replace two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins and lugs [P-1].
- 33.1.7 Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer; perform needed action [P-1].
- 33.1.8 Inspect, adjust and replace self-adjusting or continuous-adjusting clutch mechanisms [P-2].
- 33.1.9 Inspect and replace pilot bearing [P-1].
- 33.1.10 Inspect flywheel mounting area on crankshaft and rear main oil seal; measure crankshaft end play; determine needed action [P-1].
- 33.1.11 Inspect flywheel and starter ring gear; measure flywheel face and pilot bore runout; determine needed action [P-1].
- 33.1.12 Inspect flywheel housing(s) to transmission housing/engine mating surface(s), and measure flywheel housing face and bore runout; determine needed 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)
- *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 33.2: **Diagnose and repair transmission.**

Descriptors:

- 33.2.1 Diagnose transmission noise, shifting, lockup, jumping-out-of-gear, overheating and vibration problems; determine needed action [P-1].
- 33.2.2 Diagnose the cause of transmission component failure, both before and during disassembly procedures; determine needed action [P-2].
- 33.2.3 Inspect, adjust, service, repair or replace transmission remote shift linkages, brackets, bushings, pivots and levers [P-2].
- 33.2.4 Inspect, test, repair or replace air shift controls, lines, hoses, valves, regulators, filters and cylinder assemblies [P-1].
- 33.2.5 Inspect and replace transmission mounts, insulators and mounting bolts; determine needed action [P-3].
- 33.2.6 Inspect for leakage and replace transmission cover plate, gaskets, seals and cap bolts; inspect seal surfaces and vents; repair as needed [P-1].
- 33.2.7 Check transmission fluid level and condition; determine needed service; add proper type of lubricant [P-1].
- 33.2.8 Inspect, adjust and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts and safety wires [P-2].
- 33.2.9 Remove and reinstall transmission [P-1].
- 33.2.10 Inspect input shaft, gear, spacers, bearings, retainers and slingers; replace as needed [P-3].
- 33.2.11 Inspect and adjust main shaft, gears, sliding clutches, washers, spacers, bushings, bearings, auxiliary drive assemblies, retainers and keys; replace as needed [P-3].
- 33.2.12 Inspect countershafts, gears, bearings, retainers and keys; adjust bearing preload and time multiple countershaft gears; replace as needed [P-3].

- 33.2.13 Inspect output shafts, gears, washers, spacers, bearings, retainers and keys; replace as needed [P-3].
- 33.2.14 Inspect reverse idler shafts, gears, bushings, bearings, thrust washers and retainers; check reverse idler gear end play (if applicable); replace as needed [P-3].
- 33.2.15 Inspect synchronizer hub, sleeve, keys (inserts), springs, blocking rings, synchronizer plates, blocker pins and sliding clutches; replace as needed [P-3].
- 33.2.16 Inspect transmission cases, including surfaces, bores, bushings, pins, studs and magnets; replace as needed [P-3].
- 33.2.17 Inspect transmission lubrication system pumps, troughs, collectors and slingers; service or replace as needed [P-3].
- 33.2.18 Inspect transmission oil filters and coolers; replace as needed [P-2].
- 33.2.19 Inspect mechanical and electronic speedometer components; determine needed action [P-2].
- 33.2.20 Inspect and adjust power takeoff (PTO) assemblies, controls and shafts; perform needed action [P-3].
- 33.2.21 Inspect and test function of backup light, neutral start and warning device circuits; repair as needed [P-1].
- 33.2.22 Inspect and test transmission temperature gauge and sending unit or sensor; determine needed action [P-2].
- 33.2.23 Inspect, test operation, adjust, repair or replace automated mechanical transmission and manual electronic shift controls; shift, range and splitter solenoids; shift motors; indicators, speed and range sensors; electronic control units (ECUs); transmission control units (TCUs); neutral, in-gear and reverse switches; and wiring harnesses [P-2].
- 33.2.24 Inspect, test operation, repair or replace automated mechanical transmission electronic shift selectors; air and electrical switches, displays and indicators; wiring harnesses; and air lines [P-2].
- 33.2.25 Use appropriate diagnostic tools and procedures to diagnose automated mechanical transmission problems; check and record diagnostic codes, clear codes and interpret digital multimeter (DMM) readings; determine needed repairs [P-2].
- 33.2.26 Inspect, test operation, adjust, repair or replace automatic transmission electronic and manual shift controls; shift solenoids; shift motors; indicators; speed and range sensors; ECUs; TCUs; neutral, in-gear and reverse switches; and wiring harnesses [P-3].
- 33.2.27 Inspect, test operation, repair or replace automatic transmission electronic shift selectors, switches, displays and indicators, and wiring harnesses [P-3].
- 33.2.28 Use appropriate diagnostic tools and procedures to diagnose automatic transmission problems; check and record diagnostic codes, clear codes and interpret DMM readings; determine needed repairs [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)
- *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**

EDU:	12	AD
	I	P

Competency 33.3: **Diagnose and repair driveshaft and universal joint.**

Descriptors:

- 33.3.1 Diagnose driveshaft and universal joint noise and vibration problems; determine needed action [P-1].
- 33.3.2 Inspect, service or replace driveshaft, slip joints, yokes, drive flanges and universal joints; check phasing of all yokes [P-1].
- 33.3.3 Inspect driveshaft center support bearings and mounts; determine needed action [P-1].
- 33.3.4 Measure and adjust drive line angles [P-1].

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)
- *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)
- *Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology.* (Geometry and Spatial Sense 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

EDU:	12	AD
	I	P

Competency 33.4: Diagnose and repair drive axle.

Descriptors:

- 33.4.1 Diagnose drive axle(s) drive unit noise and overheating problems; determine needed action [P-2].
- 33.4.2 Check and repair fluid leaks; inspect and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs and seals [P-1].
- 33.4.3 Check drive axle fluid level and condition; determine needed service; add proper type of lubricant [P-1].
- 33.4.4 Remove and replace differential carrier assembly [P-2].
- 33.4.5 Inspect and replace differential case assembly, including spider gears, cross shaft, side gears, thrust washers, case halves and bearings [P-3].
- 33.4.6 Inspect and replace components of locking differential case assembly [P-3].
- 33.4.7 Inspect differential carrier case and caps, side bearing bores and pilot (spigot, pocket) bearing bore; determine needed action [P-3].
- 33.4.8 Measure ring gear runout; determine needed action [P-3].
- 33.4.9 Inspect and replace ring and drive pinion gears, spacers, sleeves, bearing cages and bearings [P-3].
- 33.4.10 Measure and adjust drive pinion bearing preload [P-3].
- 33.4.11 Measure and adjust drive pinion depth [P-3].
- 33.4.12 Measure and adjust side bearing preload and ring gear backlash [P-3].
- 33.4.13 Check and interpret ring gear and pinion tooth contact pattern; determine needed action [P-3].
- 33.4.14 Inspect, adjust or replace ring gear thrust block and bolt [P-3].
- 33.4.15 Inspect, adjust, repair or replace planetary gear-type, two-speed axle assembly, including case, idler pinion, pins, thrust washers, sliding clutch gear, shift fork pivot, seals, cover and springs [P-3].
- 33.4.16 Inspect, repair or replace two-speed axle shift control system, speedometer adapters, motors, axle shift units, wires, air lines and connectors [P-3].
- 33.4.17 Inspect power divider (inter-axle differential) assembly; determine needed action [P-3].
- 33.4.18 Inspect, adjust, repair or replace air-operated poser divider (inter-axle differential) lockout assembly, including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings and controls [P-2].
- 33.4.19 Inspect, repair or replace drive axle lubrication system, including pump, troughs, collectors, slingers, tubes and filters [P-3].
- 33.4.20 Inspect and replace drive axle shafts [P-1].
- 33.4.21 Remove and replace wheel assembly; check rear wheel seal and axle flange gasket for leaks; perform needed action [P-1].
- 33.4.22 Diagnose drive axle for wheel bearing noise and damage; perform needed action [P-1].
- 33.4.23 Inspect and test drive axle temperature gauge and sending unit or sensor; determine needed action [P-2].
- 33.4.24 Clean, inspect, lubricate and replace wheel bearings; replace seals and wear rings; adjust drive axle wheel bearings [P-1].

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)*
- *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)*
- *Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology. (Geometry and Spatial Sense 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)*

Unit 34: Brakes

Note: Throughout Unit 34, students are expected to learn and use vocabulary specific to the medium and heavy transportation equipment technology 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 34.1: Diagnose and repair air brakes.

Descriptors:

- 34.1.1 Diagnose poor stopping, air leaks, premature wear, pulling, grabbing or dragging problems caused by supply and service system malfunctions; determine needed action [P-1].
- 34.1.2 Check air system buildup time; determine needed action [P-1].
- 34.1.3 Drain air reservoir tanks; check for oil, water and foreign material; determine needed action [P-1].
- 34.1.4 Inspect, adjust and align compressor drive belts, pulleys and tensioners; replace as needed [P-1].
- 34.1.5 Inspect compressor drive gear and coupling; replace as needed [P-3].
- 34.1.6 Inspect air compressor, air cleaner and air supply; inspect oil supply and coolant lines, fittings and mounting brackets; repair or replace as needed [P-2-R].
- 34.1.7 Inspect and test system pressure controls, including governor, unloader assembly valves, intake screens, filters, lines, hoses and fittings; replace as needed [P-1].
- 34.1.8 Inspect air system lines, hoses, fittings and couplings; repair or replace and needed [P-1].
- 34.1.9 Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check-valves, manual and automatic drain valves; replace as needed [P-1].
- 34.1.10 Inspect and clean air drier systems, filters, valves, heaters, wiring and connectors; repair or replace as needed [P-1].
- 34.1.11 Inspect and test brake application (foot) valve, fittings and mounts; adjust or replace as needed [P-1].
- 34.1.12 Inspect and test stoplight circuit switches, wiring and connectors; repair or replace as needed [P-1].
- 34.1.13 Inspect and test hand brake (trailer) control valve, lines, fittings and mountings; repair or replace as needed [P-1].
- 34.1.14 Inspect and test brake relay valve; replace as needed [P-1].
- 34.1.15 Inspect and test quick release valves; replace as needed [P-1].
- 34.1.16 Inspect and test front and rear axle limiting (proportioning) valves; replace as needed [P-3].

- 34.1.17 Inspect and test tractor protection valve; replace as needed [P-1].
- 34.1.18 Inspect and test emergency (spring) brake control and modulator valve(s); replace as needed [P-1].
- 34.1.19 Inspect and test low pressure warning devices, wiring and connectors; replace as needed [P-1].
- 34.1.20 Inspect and test air pressure gauges, lines and fittings; replace as needed [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

EDU:	12	AD
	I	P

Competency 34.2: Diagnose and repair mechanical and foundation brakes.

Descriptors:

- 34.2.1 Diagnose poor stopping, brake noise, premature wear, pulling, grabbing or dragging problems caused by the foundation brake, slack adjuster and brake chamber problems; determine needed action [P-1].
- 34.2.2 Inspect and test service brake chambers, diaphragm, clamp, spring, pushrod, clevis and mounting brackets; repair or replace as needed [P-1].
- 34.2.3 Inspect and service manual and automatic slack adjusters; perform needed action [P-1].
- 34.2.4 Inspect camshafts, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins and springs; replace as needed [P-1].
- 34.2.5 Inspect, clean and adjust air disc brake caliper assemblies; determine needed repairs [P-3].
- 34.2.6 Inspect and measure brake shoes, linings or pads; perform needed action [P-1].
- 34.2.7 Inspect and measure brake drums and rotors; perform needed 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)
- *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 34.3: Diagnose and repair parking brakes.

Descriptors:

- 34.3.1 Inspect and test parking (spring) brake chamber diaphragm and seals; replace parking (spring) brake chamber; dispose of removed chambers in accordance with local regulations [P-1].
- 34.3.2 Inspect and test parking (spring) brake check valves, lines, hoses and fittings; replace as needed [P-1].
- 34.3.3 Inspect and test parking (spring) brake application and release valve; replace as needed [P-2].
- 34.3.4 Release (cage) manually and reset (uncage) parking (spring) brakes in accordance with manufacturer's recommendations [P-1].

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

- *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 35: Hydraulic Brakes

BIL: Essential

EDU:	12	AD
	I	P

Competency 35.1: Diagnose and repair hydraulic brakes.

Descriptors:

- 35.1.1 Diagnose poor stopping, premature wear, pulling, dragging or pedal feel problems caused by the hydraulic system; determine needed action [P-1].
- 35.1.2 Check brake pedal pushrod length; adjust as needed [P-3].
- 35.1.3 Inspect and test master cylinder for internal and external leaks and damage; replace as needed [P-1].
- 35.1.4 Inspect brake lines, flexible hoses and fittings for leaks and damages: replace as needed [P-1].
- 35.1.5 Inspect and test metering (hold-off), load sensing and proportioning, and proportioning and combination valves; replace as needed [P-2].
- 35.1.6 Inspect and test brake pressure differential valve and warning light circuit switch, bulbs, wiring and connectors; repair or replace as needed [P-2].
- 35.1.7 Inspect and clean wheel cylinders; replace as needed [P-1].
- 35.1.8 Inspect and clean disc brake caliper assemblies; replace as needed [P-1].
- 35.1.9 Inspect and test brake fluid; bleed and/or flush system; determine proper fluid type [P-1].
- 35.1.10 Test and adjust brake stop light switch, bulbs, wiring and connectors; repair or replace as needed [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 35.2: Diagnose and repair mechanical and foundation brakes.

Descriptors:

- 35.2.1 Diagnose poor stopping, brake noise, premature wear, pulling, grabbing, dragging or pedal feel problems; determine needed action [P-1].
- 35.2.2 Inspect and measure brake drums and rotors; perform needed action [P-1].
- 35.2.3 Inspect and measure drum brake shoes and linings; inspect mounting hardware, adjuster mechanisms and backing plates; perform needed action [P-1].
- 35.2.4 Inspect and measure disc brake pads and linings; inspect mounting hardware; perform needed action [P-1].
- 35.2.5 Check parking brake operation; inspect parking brake application and holding devices; adjust and replace as needed [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)

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 35.3: Diagnose and repair power assist units.

Descriptors:

- 35.3.1 Diagnose stopping problems caused by the brake assist (booster) system; determine needed action [P-2].
- 35.3.2 Inspect, test, repair or replace power brake assist (booster), hoses and control valves; determine proper fluid type [P-2].
- 35.3.3 Check emergency (back-up, reserve) brake assist system [P-2].

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)

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 35.4: Diagnose and service air and hydraulic antilock brake systems (ABS) and automatic traction control (ATC).

Descriptors:

- 35.4.1 Observe antilock brake system (ABS) warning light operation, including dash-mounted trailer ABS warning light; determine needed action [P-1].
- 35.4.2 Diagnose ABS electronic control(s) and components using self-diagnosis and/or specified test equipment (e.g., scan tool, PC computer); determine needed action [P-1].
- 35.4.3 Diagnose poor stopping and wheel lock-up caused by failure of the ABS; determine needed action [P-1].
- 35.4.4 Inspect, test and replace ABS air, hydraulic, electrical and mechanical components; perform needed action [P-1].
- 35.4.5 Diagnose, service and adjust ABS wheel speed sensors and circuits following manufacturer's recommended procedures, including voltage output, resistance, short to voltage or ground and frequency data [P-1].
- 35.4.6 Bleed the ABS hydraulic circuits following manufacturer's procedures [P-2].
- 35.4.7 Observe automatic traction control (ATC) warning light operation; determine needed action [P-3].
- 35.4.8 Diagnose ATC electronic control(s) and components using self-diagnosis and/or specified test equipment (e.g., scan tool, PC computer); determine needed action [P-3].

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

- *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 36: Suspension and Steering

Note: Throughout Unit 36, students are expected to learn and use vocabulary specific to the medium and heavy transportation equipment technology 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 36.1: Diagnose and repair steering column.

Descriptors:

- 36.1.1 Diagnose fixed and driver adjustable steering column and shaft noise, looseness and binding problems; determine needed action [P-1].
- 36.1.2 Inspect steering shaft U-joint(s), slip joints, bearings, bushings and seals; phase shaft U-joints; determine needed action [P-1].
- 36.1.3 Check and adjust cab mounting and ride height [P-1].
- 36.1.4 Center the steering wheel as needed [P-1].
- 36.1.5 Disable and enable supplemental restraint system (SRS) in accordance with manufacturer's procedures [P-1].

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

- *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 36.2: Diagnose and repair steering units.

Descriptors:

- 36.2.1 Diagnose power steering system noise, steering binding, darting or oversteer, reduced wheel cut, steering wheel kick, pulling, non-recovery, turning effort, looseness, hard steering, overheating, fluid leakage and fluid aeration problems; determine needed action [P-1].
- 36.2.2 Determine recommended type of power steering fluid; check level and condition [P-1].
- 36.2.3 Flush and refill power steering system; purge air from system [P-2].
- 36.2.4 Perform power steering system pressure, temperature and flow tests; determine needed action [P-2].
- 36.2.5 Inspect, service or replace power steering reservoir, including filter, seals and gaskets [P-2].
- 36.2.6 Inspect and reinstall or replace pulleys, tensioners and drive belts; adjust drive belts and check alignment [P-1].
- 36.2.7 Inspect power steering pump drive gear and coupling, and replace as required [P-3].
- 36.2.8 Inspect, adjust or replace power steering pump, mountings and brackets [P-3].
- 36.2.9 Inspect and replace power steering system cooler, lines, hoses, clamps and mountings, hose routings, and fittings [P-3].
- 36.2.10 Inspect, adjust or replace linkage-assist type power steering cylinder or gear (dual system) [P-3].
- 36.2.11 Inspect, adjust, repair or replace integral type power steering gear and mountings [P-1].
- 36.2.12 Adjust manual and automatic steering gear poppet and relief valves [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

EDU:	12	AD
	I	P

Competency 36.3: Diagnose and repair steering linkage.

Descriptors:

- 36.3.1 Inspect and align pitman arm; replace as needed [P-1].
- 36.3.2 Inspect drag link (relay rod) and tie rod ends; adjust or replace as needed [P-1].
- 36.3.3 Inspect steering arm and levers and linkage pivot joints; replace as needed [P-1].
- 36.3.4 Inspect clamps and retainers on cross tube, relay rod, centerlink and tie rod; position or replace as needed [P-1].
- 36.3.5 Check and adjust wheel stops [P-1].
- 36.3.6 Lubricate steering linkage joints as needed [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

EDU:	12	AD
	I	P

Competency 36.4: Diagnose and repair suspension systems.

Descriptors:

- 36.4.1 Inspect front axles, U-bolts and nuts; determine needed action [P-1].
- 36.4.2 Inspect and service king pin, steering knuckle bushings, locks, bearings, seals and covers; determine needed action [P-1].
- 36.4.3 Inspect shock absorbers, bushings, brackets and mounts; replace as needed [P-1].
- 36.4.4 Inspect leaf springs, center bolts, clips, eye bolts and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed action [P-1].
- 36.4.5 Inspect torque arms, bushing and mounts; determine needed action [P-1].
- 36.4.6 Inspect axle aligning devices such as radius rods, track bars, stabilizer bars and related bushings, mounts, shims and cams; determine needed action [P-1].

- 36.4.7 Inspect walking beams, center (cross) tube, bushings, mounts, load pads, saddles and caps; replace as needed [P-3].
- 36.4.8 Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves and fittings; adjust, repair or replace as needed [P-1].
- 36.4.9 Inspect and test air springs, mounting plates, springs, suspension arms and bushings; replace as needed [P-1].
- 36.4.10 Measure vehicle ride height; determine needed action [P-1].
- 36.4.11 Diagnose rough ride problems; determine needed 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)
- *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)

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 36.5: Diagnose, adjust and repair wheel alignment.

Descriptors:

- 36.5.1 Diagnose vehicle wandering, pulling, shimmy, hard steering and off-center steering wheel problem(s); adjust and repair as needed [P-1].
- 36.5.2 Check camber; determine needed action [P-2].
- 36.5.3 Check caster; adjust as needed [P-2].
- 36.5.4 Check toe; adjust as needed [P-1].
- 36.5.5 Check rear axle(s) alignment (thrustline and centerline) and tracking; adjust or repair as needed [P-2].
- 36.5.6 Diagnose turning and Ackerman angle problems (toe-out-on-turns); determine needed action [P-3].
- 36.5.7 Check front axle alignment (centerline); adjust or repair as needed [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)

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 36.6: Diagnose and repair wheels and tires.

Descriptors:

- 36.6.1 Diagnose unusual tire wear patterns, check tread depth, mismatched tread design; determine needed action [P-1].
- 36.6.2 Diagnose wheel or tire vibration, shimmy, pounding and hop (tramp) problems; determine needed 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)

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 36.7: Diagnose and repair frame

Descriptors:

- 36.7.1 Inspect and adjust fifth wheel, pivot pins, bushings, locking jaw mechanisms and mounting bolts; determine needed action [P-1].
- 36.7.2 Inspect sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses and controls [P-1].
- 36.7.3 Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness and damage; determine needed repairs [P-1].
- 36.7.4 Inspect, install or repair frame hangers, brackets and cross members in accordance with manufacturer's recommended procedures [P-3].
- 36.7.5 Inspect, repair or replace pintle hooks and draw bars [P-1].

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

- *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)

Unit 37: Electrical and Electronic Systems

Note: Throughout Unit 37, students are expected to learn and use vocabulary specific to the medium and heavy transportation equipment technology 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 37.1: Diagnose general electrical systems.

Descriptors:

- 37.1.1 Read, interpret and diagnose electrical and electronic circuits using wiring diagrams [P-1].
- 37.1.2 Check continuity in electrical and electronic circuits using appropriate test equipment [P-1].
- 37.1.3 Check applied voltages, circuit voltages and voltage drops in electrical and electronic circuits using a digital multimeter (DMM) [P-1].
- 37.1.4 Check current flow in electrical and electronic circuits and components using a DMM or clamp-on ammeter [P-1].
- 37.1.5 Check resistance in electrical and electronic circuits and components using a DMM [P-1].
- 37.1.6 Find shorts, grounds and opens in electrical and electronic circuits [P-1].
- 37.1.7 Diagnose parasitic (key-off) battery drain problems [P-1].
- 37.1.8 Inspect and test fusible links, circuit breakers, relays, solenoids and fuses; replace as needed [P-1].
- 37.1.9 Inspect and test spike suppression diodes and resistors; replace as needed [P-3].
- 37.1.10 Check frequency and pulse width in electrical and electronic circuits using appropriate test equipment [P-3].

Correlated English Language Arts Academic Content Benchmarks

- *Analyze whether graphics supplement textual information and promote the author's purpose.* (Reading: Informational, Technical and Persuasive Text C, 8-10)

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 37.2: **Diagnose and repair battery.**

Descriptors:

- 37.2.1 Perform battery load test; determine needed action [P-1].
- 37.2.2 Determine battery state of charge using an open circuit voltage test [P-1].
- 37.2.3 Inspect, clean and service battery; replace as needed [P-1].
- 37.2.4 Inspect and clean battery boxes, mounts and hold downs; repair or replace as needed [P-1].
- 37.2.5 Charge battery using slow or fast charge method as appropriate [P-1].
- 37.2.6 Inspect, test and clean battery cables and connectors; repair or replace as needed [P-1].
- 37.2.7 Jump start a vehicle using jumper cables and a booster battery or auxiliary power supply, observing proper safety procedures [P-1].
- 37.2.8 Perform battery capacitance test; determine needed 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

EDU:	12	AD
	I	P

Competency 37.3: Diagnose and repair starting system.

Descriptors:

- 37.3.1 Perform starter circuit cranking voltage and voltage drop tests; determine needed action [P-1].
- 37.3.2 Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed [P-2].
- 37.3.3 Inspect and test starter relays, solenoids and switches; replace as needed [P-2].
- 37.3.4 Remove and replace starter; inspect flywheel ring gear or flex plate [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

EDU:	12	AD
	I	P

Competency 37.4: Diagnose and repair charging system.

Descriptors:

- 37.4.1 Diagnose instrument panel-mounted volt meters and/or indicator lamps that show a no charge, low charge or overcharge condition; determine needed action [P-1].
- 37.4.2 Diagnose the cause of a no charge, low charge or overcharge condition; determine needed action [P-1].
- 37.4.3 Inspect and replace alternator drive belts, pulleys, fans, tensioners and mounting brackets; adjust drive belts and check alignment [P-1].
- 37.4.4 Perform charging system voltage and amperage output tests; determine needed action [P-1].
- 37.4.5 Perform charging circuit voltage drop tests; determine needed action [P-1].
- 37.4.6 Remove and replace alternator [P-2].
- 37.4.7 Inspect, repair or replace connectors and wires in the charging circuit [P-2].
- 37.4.8 Diagnose AC voltage leakage (failed rectifier) at alternator output; determine needed 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)

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 37.5: **Diagnose and repair lighting systems.**

Descriptors:

- 37.5.1 Diagnose the cause of brighter than normal, intermittent, dim or no headlight and daytime running light (DRL) operation [P-1].
- 37.5.2 Test, aim and replace headlights [P-1].
- 37.5.3 Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets and control components; repair or replace as needed [P-1].
- 37.5.4 Inspect and test switches, bulbs, light emitting diodes (LEDs), sockets, connectors, terminals, relays and wires of parking, clearance and taillight circuits; repair or replace as needed [P-1].
- 37.5.5 Inspect and test instrument panel light circuit switches, relays, bulbs, sockets, connectors, terminals, wires, and printed circuits and control modules; repair or replace as needed [P-2].
- 37.5.6 Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals and wires; repair or replace as needed [P-2].
- 37.5.7 Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed [P-1].
- 37.5.8 Inspect, test and adjust stoplight circuit switches, bulbs, LEDs, sockets, connectors, terminals and wires; repair or replace as needed [P-1].
- 37.5.9 Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs, LEDs, sockets, connectors, terminals and wires; repair or replace as needed [P-1].
- 37.5.10 Inspect, test and adjust backup lights and warning device circuit switches, bulbs, LEDs, sockets, horns, buzzers, connectors, terminals and wires; repair or replace as needed [P-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**

EDU:	12	AD
	I	P

Competency 37.6: Diagnose and repair gauges and warning devices.

Descriptors:

- 37.6.1 Interface with vehicle's on-board computer; perform diagnostic procedure using recommended electronic diagnostic equipment and tools, including PC-based software and/or data scan tools; determine needed action [P-1].
- 37.6.2 Diagnose the cause of intermittent, high, low or no gauge readings; determine needed action [P-2].
- 37.6.3 Diagnose the cause of data bus-driven gauge malfunctions; determine needed action [P-3].
- 37.6.4 Inspect and test gauge circuit sending units, gauges, connectors, terminals and wires; repair or replace as needed [P-2].
- 37.6.5 Inspect and test warning devices (lights and audible) circuit sending units, bulbs, LEDs, sockets, connectors, wires, and printed circuits and control modules; repair or replace as needed [P-2].
- 37.6.6 Inspect, test, replace and calibrate (if applicable) electronic speedometer, odometer and tachometer 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)
- *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 37.7: Diagnose and repair related electrical systems.

Descriptors:

- 37.7.1 Diagnose the cause of constant, intermittent or no horn operation; determine needed action [P-2].
- 37.7.2 Inspect and test horn circuit relays, horns, switches, connectors and wires; repair or replace as needed [P-2].
- 37.7.3 Diagnose the cause of constant, intermittent or no wiper operation; diagnose the cause of wiper speed control and/or park problems; determine needed action [P-2].
- 37.7.4 Inspect and test wiper motor, resistors, park switch, relays, switches, connectors and wires; repair or replace as needed [P-2].
- 37.7.5 Inspect wiper motor transmission linkage, arms and blades; adjust or replace as needed [P-2].
- 37.7.6 Inspect and test windshield washer motor or pump and relay assembly, switches, connectors, terminals and wires; repair or replace as needed [P-3].
- 37.7.7 Inspect and test side view mirror motors, heater circuit grids, relays, switches, connectors, terminals and wires; repair or replace as needed [P-3].
- 37.7.8 Inspect and test heater and A/C electrical components, including A/C clutches, motors, resistors, relays, switches, connectors, terminals and wires; repair or replace as needed [P-3].
- 37.7.9 Inspect and test auxiliary power outlet, integral fuse, connectors, terminals and wires; repair or replace as needed [P-3].
- 37.7.10 Diagnose the cause of slow, intermittent or no power side window operation; determine needed action [P-3].
- 37.7.11 Inspect and test motors, switches, relays, connectors, terminals and wires of power side window circuits; repair or replace as needed [P-3].
- 37.7.12 Inspect block heaters; determine needed repairs [P-2].
- 37.7.13 Inspect and test cruise control electrical components; repair or replace as needed [P-3].
- 37.7.14 Inspect and test engine cooling fan electrical control components; repair or replace as needed [P-2].
- 37.7.15 Diagnose the cause of data bus communication problems; determine needed 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 how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)
- *Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

Unit 38: Heating, Ventilation and Air Conditioning (HVAC)

Note: Throughout Unit 38, students are expected to learn and use vocabulary specific to the medium and heavy transportation equipment technology 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 38.1: Diagnose, service and repair HVAC systems.

Descriptors:

- 38.1.1 Verify the need for service or repair of HVAC systems based on unusual operating noises; determine needed action [P-1].
- 38.1.2 Verify the need for service or repair of HVAC systems based on unusual visual, smell and touch conditions; determine needed action [P-1].
- 38.1.3 Identify system type and components (i.e., cycling clutch orifice tube [CCOT], expansion valve) and conduct performance test(s) on HVAC systems; determine needed 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)
- *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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 38.2: Diagnose, service and repair air conditioning (A/C) system and components.

Descriptors:

- 38.2.1 Diagnose the cause of temperature control problems in the A/C system; determine needed action [P-1].
- 38.2.2 Identify refrigerant type and check for contamination; determine needed action [P-2].
- 38.2.3 Diagnose A/C system problems indicated by pressure gauge and temperature readings; determine needed action [P-1].
- 38.2.4 Diagnose A/C system problems indicated by visual, audible, smell and touch procedures; determine needed action [P-1].
- 38.2.5 Perform A/C system leak test; determine needed action [P-1].
- 38.2.6 Evacuate A/C system using appropriate equipment [P-1].
- 38.2.7 Internally clean contaminated A/C system components and hoses [P-2].
- 38.2.8 Charge A/C system with refrigerant [P-1].
- 38.2.9 Identify the lubricant type needed for system application [P-1].
- 38.2.10 Diagnose A/C system problems that cause protection devices, including pressure, thermal and electronic, to interrupt system operation; determine needed action [P-1].
- 38.2.11 Inspect, test and replace A/C system pressure, thermal and electronic protection devices [P-2].
- 38.2.12 Inspect and replace A/C compressor drive belts, pulleys and tensioners; adjust belt tension and check alignment [P-1].
- 38.2.13 Inspect, test, service and replace A/C compressor clutch components or assembly [P-3].
- 38.2.14 Inspect and correct A/C compressor lubricant level, if applicable [P-2].
- 38.2.15 Inspect, test and replace A/C compressor [P-2].
- 38.2.16 Inspect, repair or replace A/C compressor mountings and hardware [P-2].
- 38.2.17 Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier and hoses [P-1].
- 38.2.18 Inspect A/C system hoses, lines, filters, fittings and seals; determine needed action [P-1].
- 38.2.19 Inspect A/C condenser for proper air flow [P-1].
- 38.2.20 Inspect and test A/C system condenser and mountings; determine needed action [P-2].
- 38.2.21 Inspect and replace receiver/drier or accumulator/drier [P-1].
- 38.2.22 Inspect and test cab or sleeper refrigerant solenoid and expansion valve(s); check placement of thermal bulb (capillary tube); determine needed action [P-3].
- 38.2.23 Inspect and replace orifice tube [P-1].
- 38.2.24 Inspect and test cab or sleeper evaporator core; determine needed action [P-3].
- 38.2.25 Inspect, clean and repair evaporator housing and water drain; inspect and service or replace evaporator air filter [P-1].
- 38.2.26 Identify and inspect A/C system service ports (gauge connections); determine needed action [P-1].
- 38.2.27 Diagnose system failures resulting in refrigerant loss from the A/C system high pressure relief device; determine needed action [P-2].

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

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 38.3: **Diagnose, service and repair heating and engine cooling systems.**

Descriptors:

- 38.3.1 Diagnose the cause of outlet air temperature control problems in the HVAC system; determine needed action [P-1].
- 38.3.2 Diagnose window fogging problems; determine needed action [P-2].
- 38.3.3 Inspect and test heating system coolant control valve(s) and manual shut-off valves; determine needed action [P-2].
- 38.3.4 Inspect and flush heater core; determine needed action [P-2].
- 38.3.5 Inspect and test radiator, pressure cap and coolant recovery system (surge tank); determine needed action [P-1].
- 38.3.6 Inspect water pump for leaks and bearing play; determine needed action [P-2].
- 38.3.7 Inspect and test thermostats, by-passes, housings and seals; determine needed repairs [P-2].
- 38.3.8 Recover, flush and refill with recommended coolant/additive package; bleed cooling system [P-1].
- 38.3.9 Inspect thermostatic cooling fan system (hydraulic, pneumatic and electronic) and fan shroud; replace as needed [P-2].
- 38.3.10 Inspect and test heating system coolant control valve(s) and manual shut-off valves; determine needed action [P-2].
- 38.3.11 Inspect and flush heater core; determine needed action [P-2].

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 how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)
- *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 38.4: **Diagnose, service and repair operating systems and related electrical controls.**

Descriptors:

- 38.4.1 Diagnose the cause of failures in HVAC electrical control systems; determine needed action [P-1].
- 38.4.2 Inspect and test A/C heater blower motors, resistors, switches, relays, modules, wiring and protection devices; determine needed action [P-2].
- 38.4.3 Inspect and test A/C compressor clutch relays, modules, wiring, sensors, switches, diodes and protection devices; determine needed action [P-2].
- 38.4.4 Inspect and test A/C-related electronic engine control systems; determine needed action [P-2].
- 38.4.5 Inspect and test engine cooling and condenser fan motors, relays, modules, switches, sensors, wiring and protection devices; determine needed action [P-2].
- 38.4.6 Inspect and test electric actuator motors, relays, modules, switches, sensors, wiring and protection devices; determine needed action [P-3].
- 38.4.7 Inspect and test HVAC system electrical control panel assemblies; determine needed 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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 38.5: Diagnose, service and repair operating systems and related air, vacuum and mechanical controls.

Descriptors:

- 38.5.1 Diagnose the cause of failures in HVAC air, vacuum and mechanical switches and controls; determine needed action [P-1].
- 38.5.2 Inspect and test HVAC system air, vacuum and mechanical control panel assemblies; determine needed action [P-3].
- 38.5.3 Inspect, test and adjust HVAC system air, vacuum and mechanical control cables and linkages; determine needed action [P-3].
- 38.5.4 Inspect and test HVAC system vacuum actuators (diaphragms, motors) and hoses; determine needed action [P-3].
- 38.5.5 Inspect and test HVAC system vacuum reservoir(s); check valve(s) and restrictors; determine needed action [P-3].
- 38.5.6 Inspect, test and adjust HVAC system duct, doors and outlets; determine needed 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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 38.6: Recover, recycle and handle refrigerant.

Descriptors:

- 38.6.1 Maintain and verify correct operation of certified equipment [P-1].
- 38.6.2 Identify, either by label application or by use of a refrigerant identifier, and recover A/C system refrigerant [P-1].
- 38.6.3 Recycle refrigerant [P-1].
- 38.6.4 Handle, label and store refrigerant [P-1].
- 38.6.5 Test recycled refrigerant for non-condensable gases [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 Science Academic Content Benchmarks

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

Unit 39: Preventive Maintenance Inspection

Note: Throughout Unit 39, students are expected to learn and use vocabulary specific to the medium and heavy transportation equipment technology 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 39.1: Perform preventative engine system maintenance.

Descriptors:

- 39.1.1 Check engine starting and operation, including unusual noises, vibration and exhaust smoke; record idle and governed revolutions per minute (RPM) [P-1].
- 39.1.2 Inspect vibration damper [P-1].
- 39.1.3 Inspect belts, tensioners and pulleys; check and adjust belt tension; check belt alignment [P-1].
- 39.1.4 Check engine oil level; check engine for oil, coolant and fuel leaks (engine off) [P-1].
- 39.1.5 Inspect engine mounts for looseness and deterioration [P-1].
- 39.1.6 Check engine for oil, coolant, air, fuel and exhaust leaks (engine running) [P-1].
- 39.1.7 Check electrical wiring, routing and hold-down clamps, including engine control module (ECM) and power train control module (PCM) [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)
- *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

EDU:	12	AD
	I	P

Competency 39.2: Perform preventative fuel system maintenance.

Descriptors:

- 39.2.1 Check fuel tanks, mountings, lines, caps and vents [P-1].
- 39.2.2 Inspect throttle linkages and return springs [P-1].
- 39.2.3 Drain water from fuel system [P-1].
- 39.2.4 Inspect water separator and fuel heater; replace fuel filter(s); prime and bleed fuel system [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)
- *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**

EDU:	12	AD
	I	P

Competency 39.3: Perform preventative air induction and exhaust system maintenance.

Descriptors:

- 39.3.1 Check exhaust system mountings for looseness and damage [P-1].
- 39.3.2 Check engine exhaust system for leaks, proper routing and damaged or missing components to include exhaust gas recirculation (EGR) system, if equipped [P-1].
- 39.3.3 Check air induction system and piping; charge air cooler, hoses, clamps and mountings; check for air restrictions and leaks [P-1].
- 39.3.4 Inspect turbocharger for leaks; check mountings and connections [P-1].
- 39.3.5 Check operation of engine compression and exhaust brake [P-1].
- 39.3.6 Service or replace air filter as needed; check and reset air filter restriction indicator [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)
- *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**

EDU:	12	AD
	I	P

Competency 39.4: Perform preventative cooling system maintenance.

Descriptors:

- 39.4.1 Check operation of fan clutch [P-1].
- 39.4.2 Inspect radiator, including air flow restriction, leaks and damage, and radiator mountings [P-1].
- 39.4.3 Inspect fan assembly and shroud [P-1].
- 39.4.4 Pressure test cooling system and radiator cap [P-1].
- 39.4.5 Inspect coolant hoses and clamps [P-1].
- 39.4.6 Inspect coolant recovery system [P-1].

- 39.4.7 Check coolant for contamination and for supplemental coolant additive's (SCA's) concentration and protection level (freeze point) [P-1].
- 39.4.8 Service coolant filter and conditioner [P-1].
- 39.4.9 Inspect water pump for leaks and bearing play [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)
- *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

EDU:	12	AD
	I	P

Competency 39.5: Perform preventative lubrication system maintenance.

Descriptors:

- 39.5.1 Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs [P-1].
- 39.5.2 Take an engine oil sample [P-1].

BIL: Essential

EDU:	12	AD
	I	P

Competency 39.6: Perform preventative instruments and controls maintenance.

Descriptors:

- 39.6.1 Inspect key condition and operation of ignition switch [P-1].
- 39.6.2 Check warning indicators [P-1].
- 39.6.3 Check instruments; record oil pressure and system voltage [P-1].
- 39.6.4 Check mechanical, electronic and emergency shut down operation [P-1].
- 39.6.5 Check mechanical and electronic engine speed controls [P-1].
- 39.6.6 Check heater, ventilation and air conditioning (HVAC) controls [P-1].
- 39.6.7 Check operation of all accessories [P-1].
- 39.6.8 Use a diagnostic tool or on-board diagnostic system; extract engine monitoring information [P-1].

Correlated Mathematics Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 39.7: Perform preventative safety equipment maintenance.

Descriptors:

- 39.7.1 Check operation of electric and/or air horns and back-up warning devices [P-1].
- 39.7.2 Check condition and documentation of safety flares, spare fuses, triangles, fire extinguishers and all required decals [P-1].
- 39.7.3 Inspect seat belts and sleeper restraints [P-1].
- 39.7.4 Inspect wiper blades and arms [P-1].

BIL: Essential

EDU:	12	AD
	I	P

Competency 39.8: Perform preventative hardware maintenance.

Descriptors:

- 39.8.1 Check windshield wiper and washer operation [P-1].
- 39.8.2 Inspect windshield glass for cracks or discoloration; check sun visor [P-1].
- 39.8.3 Check seat condition, operation and mounting [P-1].
- 39.8.4 Check door glass and window operation [P-1].
- 39.8.5 Inspect steps and grab handles [P-1].
- 39.8.6 Inspect mirrors, mountings, brackets and glass [P-1].
- 39.8.7 Record all observed physical damage [P-1].
- 39.8.8 Lubricate all cab and good grease fittings [P-1].
- 39.8.9 Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages and cables [P-1].
- 39.8.10 Inspect cab mountings, hinges, latches, linkages and ride height; service as needed [P-1].
- 39.8.11 Inspect tilt cab hydraulic pump, lines and cylinders for leakage; inspect safety devices; service as needed [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)
- *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

EDU:	12	AD
	I	P

Competency 39.9: Perform preventative heating, ventilation and air conditioning (HVAC) maintenance.

Descriptors:

- 39.9.1 Inspect air conditioning (A/C) condenser and lines for condition and visible leaks; check mountings [P-1].
- 39.9.2 Inspect A/C compressor and lines for condition and visible leaks; check mountings [P-1].
- 39.9.3 Check A/C system condition and operation; check A/C monitoring system, if applicable [P-1].
- 39.9.4 Check HVAC air inlet filters and ducts; service as needed [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)
- *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

EDU:	12	AD
	I	P

Competency 39.10: Perform preventative battery and starting systems maintenance.

Descriptors:

- 39.10.1 Inspect battery box(es), cover(s) and mountings [P-1].
- 39.10.2 Inspect battery hold-downs, connections, cables and cable routing; service as needed [P-1].
- 39.10.3 Check and record battery state-of-charge (open circuit voltage) and condition [P-1].
- 39.10.4 Perform battery load and/or capacitance test(s) [P-1].
- 39.10.5 Inspect starter, mounting and connection [P-1].
- 39.10.6 Engage starter; check for unusual noises, starter drag and starting difficulty [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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 39.11: Perform preventative charging system maintenance.

Descriptors:

- 39.11.1 Inspect alternator, mountings, wiring and wiring routing; determine needed action [P-1].
- 39.11.2 Perform alternator current output test [P-1].
- 39.11.3 Perform alternator voltage output test [P-1].

Correlated Mathematics Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 39.12: Perform preventative lighting system maintenance.

Descriptors:

- 39.12.1 Check operation of interior lights; determine needed action [P-1].
- 39.12.2 Check all exterior lights, lenses, reflectors and conspicuity tape; check headlight alignment; determine needed action [P-1].
- 39.12.3 Inspect and test tractor-to-trailer multi-wire connector(s), cable(s) and holder(s); determine needed action [P-1].

BIL: Essential

EDU:	12	AD
	I	P

Competency 39.13: Perform preventative air brakes maintenance.

Descriptors:

- 39.13.1 Check parking brake operation [P-1].
- 39.13.2 Record air governor cutout setting (psi) [P-1].
- 39.13.3 Check air drier drain valve operation [P-1].
- 39.13.4 Check air system for leaks (brakes released) [P-1].
- 39.13.5 Check air system for leaks (brakes applied) [P-1].
- 39.13.6 Test one-way and double-check valves [P-1].
- 39.13.7 Check low air pressure warning devices [P-1].
- 39.13.8 Check air governor cut-in pressure [P-1].
- 39.13.9 Check emergency (spring) brake control and modulator valve, if applicable [P-1].
- 39.13.10 Check tractor protection valve [P-1].
- 39.13.11 Test air pressure build-up time [P-1].
- 39.13.12 Inspect coupling air lines, holders and gladhands [P-1].
- 39.13.13 Check brake chambers and air lines for secure mounting and damage [P-1].
- 39.13.14 Service air drier [P-1].

- 39.13.15 Inspect and record brake lining and pad condition, thickness and contamination [P-1].
- 39.13.16 Inspect and record condition of brake drums and/or rotors [P-1].
- 39.13.17 Check operation of brake manual slack adjusters; adjust as needed [P-1].
- 39.13.18 Check operation and adjustment of brake automatic slack adjusters [P-1].
- 39.13.19 Lubricate all brake component grease fittings [P-1].
- 39.13.20 Check condition and operation of hand brake (trailer) control valve [P-1].
- 39.13.21 Perform antilock brake system (ABS) operational system self-test [P-1].
- 39.13.22 Drain air tanks and check for contamination [P-1].
- 39.13.23 Check condition of pressure relief (safety) valves [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)
- *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

EDU:	12	AD
	I	P

Competency 39.14: Perform preventative hydraulic brakes maintenance.

Descriptors:

- 39.14.1 Check master cylinder fluid level and condition [P-1].
- 39.14.2 Inspect brake lines, fittings, flexible hoses and valves for leaks and damage [P-1].
- 39.14.3 Check parking brake operation; inspect parking brake application and holding devices; adjust as needed [P-1].
- 39.14.4 Check operation of hydraulic system, including pedal travel, pedal effort and pedal feel (drift) [P-1].
- 39.14.5 Inspect wheel cylinders and calipers for leakage and damage [P-1].
- 39.14.6 Inspect power brake booster(s), hoses and check or control valves; check power brake booster, reservoir fluid level and condition [P-1].
- 39.14.7 Inspect and record brake lining and pad condition, thickness and contamination [P-1].
- 39.14.8 Inspect and record condition of brake drums and/or rotors [P-1].
- 39.14.9 Adjust drum brakes [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)
- *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

EDU:	12	AD
	I	P

Competency 39.15: Perform preventative drive train maintenance.

Descriptors:

- 39.15.1 Check operation of clutch, clutch brake and gearshift [P-1].
- 39.15.2 Check clutch linkage and cable for looseness or binding, if applicable [P-1].
- 39.15.3 Check hydraulic clutch slave and master cylinders, lines, fittings and hose, if applicable [P-1].
- 39.15.4 Check clutch adjustment; adjust as needed [P-1].
- 39.15.5 Check transmission case, seals, filter, hoses and cooler for cracks and leaks [P-1].
- 39.15.6 Inspect transmission breather [P-1].
- 39.15.7 Inspect transmission mounts [P-1].
- 39.15.8 Check transmission oil level, type and condition [P-1].
- 39.15.9 Inspect U-joints, yokes, drive lines and center bearings for looseness, damage and proper phasing [P-1].
- 39.15.10 Inspect axle housing(s) for cracks and leaks [P-1].
- 39.15.11 Inspect axle breather(s) [P-1].
- 39.15.12 Lubricate all drive train grease fittings [P-1].
- 39.15.13 Check drive axle(s) oil level, type and condition [P-1].
- 39.15.14 Change drive axle(s) oil and filter; check and clean magnetic plugs [P-1].
- 39.15.15 Check two-speed axle unit operation and oil level [P-1].
- 39.15.16 Change transmission oil and filter; check and clean magnetic plugs [P-1].
- 39.15.17 Check interaxle differential lock operation [P-1].
- 39.15.18 Check range shift operation [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)
- *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

EDU:	12	AD
	I	P

Competency 39.16: Perform preventative suspension and steering systems maintenance.

Descriptors:

- 39.16.1 Check steering wheel operation for free play or binding [P-1].
- 39.16.2 Check power steering pump, mounting and hoses for leaks, condition and routing; check fluid level [P-1].
- 39.16.3 Change power steering fluid and filter [P-1].
- 39.16.4 Inspect steering gear for leaks and secure mounting [P-1].
- 39.16.5 Inspect steering shaft U-joints, pinch bolts, splines, pitman arm-to-steering sector shaft, tie rod ends, linkage and linkage-assist power steering cylinders [P-1].
- 39.16.6 Check king pin wear [P-1].
- 39.16.7 Check wheel bearings for looseness and noise [P-1].
- 39.16.8 Check oil level and condition in all non-drive hubs; check for leaks [P-1].
- 39.16.9 Remove and inspect wheel bearings; reassemble and adjust [P-1].
- 39.16.10 Inspect springs, hangers, shackles, spring U-bolts and insulators [P-1].
- 39.16.11 Inspect shock absorbers for leaks and secure mounting [P-1].
- 39.16.12 Inspect air suspension springs, mounts, hoses, valves, linkage and fittings for leaks and damage [P-1].
- 39.16.13 Check and record suspension ride height [P-1].
- 39.16.14 Lubricate all suspension and steering grease fittings [P-1].
- 39.16.15 Check toe adjustment [P-1].
- 39.16.16 Check tandem axle alignment and spacing [P-1].
- 39.16.17 Check axle locating components, including radius, torque and/or track rods [P-1].

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)*
- *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

EDU:	12	AD
	I	P

Competency 39.17: Perform preventative tires and wheels maintenance.

Descriptors:

- 39.17.1 Inspect tires for irregular wear patterns and proper mounting of directional tires [P-1].
- 39.17.2 Inspect tires for cuts, cracks, bulges and sidewall damage [P-1].
- 39.17.3 Inspect valve caps and stems; replace as needed [P-1].
- 39.17.4 Measure and record tread depth; probe for imbedded debris [P-1].
- 39.17.5 Check and record air pressure; adjust air pressure in accordance with manufacturer's specifications [P-1].
- 39.17.6 Check for loose lugs and/or slipped wheels; check mounting hardware condition; service as needed [P-1].
- 39.17.7 Re-torque lugs in accordance with manufacturer's specifications [P-1].
- 39.17.8 Inspect wheels and spacers for cracks or damage [P-1].
- 39.17.9 Check tire matching (diameter and tread) on dual tire installations [P-1].

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)
- *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

EDU:	12	AD
	I	P

Competency 39.18: Perform preventative frame and fifth wheel maintenance.

Descriptors:

- 39.18.1 Inspect fifth wheel mounting bolts, air lines and locks [P-1].
- 39.18.2 Test operation of fifth wheel locking device; adjust if necessary [P-1].
- 39.18.3 Check mud flaps and brackets [P-1].
- 39.18.4 Check pintle hook assembly and mounting [P-1].
- 39.18.5 Lubricate all fifth wheel grease fittings and plates [P-1].
- 39.18.6 Inspect frame and frame members for cracks and damage [P-1].

Unit 40: Hydraulics

BIL: Recommended

EDU:	12	AD
	I	R

Competency 40.1: Perform general system operations.

Descriptors:

- 40.1.1 Identify system type (closed and open); perform system tests and diagnosis [P-1].
- 40.1.2 Read and interpret system diagrams and schematics [P-1].
- 40.1.3 Perform system temperature, pressure, flow and cycle time tests; determine needed action [P-2].
- 40.1.4 Verify placement of equipment and component safety labels and placards; determine needed 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)
- *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

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

BIL: Recommended

EDU:	12	AD
	I	R

Competency 40.2: Diagnose and repair pumps.

Descriptors:

- 40.2.1 Verify proper fluid type [P-1].
- 40.2.2 Diagnose causes of pump failure, unusual pump noises, temperatures, flow and leakage problems; determine needed action [P-2].
- 40.2.3 Determine pump type, rotation and drive system; determine needed action [P-2].
- 40.2.4 Remove and install pump; prime and/or bleed system [P-2].
- 40.2.5 Inspect pump inlet for restrictions and leaks; repair as needed [P-2].
- 40.2.6 Diagnose root cause of pump failure; determine needed action [P-2].
- 40.2.7 Inspect pump outlet for restrictions and leaks; repair as needed [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: **Recommended**

EDU:	12	AD
	I	R

Competency 40.3: Diagnose and repair filtration system and reservoirs (tanks).

Descriptors:

- 40.3.1 Identify type of filtration system; verify filter application and flow direction [P-1].
- 40.3.2 Service filters and breathers in accordance with manufacturer’s recommended procedures [P-1].
- 40.3.3 Diagnose cause(s) of system contamination; determine needed action [P-2].
- 40.3.4 Take a hydraulic oil sample [P-2].
- 40.3.5 Check reservoir fluid level, condition and consumption; determine needed action [P-1].
- 40.3.6 Inspect and repair or replace reservoir, sight glass, vents, caps, mounts, valves, screens, supply lines and return lines [P-2].

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

- *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: Recommended

EDU:	12	AD
	I	R

Competency 40.4: Diagnose and replace hoses, fittings and connections.

Descriptors:

- 40.4.1 Diagnose causes of component leakage, damage and restriction; determine needed action [P-2].
- 40.4.2 Inspect hoses and connections, including length, size, routing, bend radii and protection; repair or replace as needed [P-1].
- 40.4.3 Assemble hoses, tubes, connectors and fittings in accordance with manufacturer's specifications; use proper procedures to avoid contamination [P-2].
- 40.4.4 Inspect and replace fitting seals and sealants [P-2].

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

- *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: Recommended

EDU:	12	AD
	I	R

Competency 40.5: Diagnose and repair control valves.

Descriptors:

- 40.5.1 Pressure test system safety relief valve; determine needed action [P-2].
- 40.5.2 Perform control valve operating pressure and flow tests; determine needed action [P-2].
- 40.5.3 Inspect, test and adjust valve controls, including electrical, electronic, mechanical and pneumatic [P-2].
- 40.5.4 Diagnose control valve leakage (internal or external); determine needed action [P-2].
- 40.5.5 Inspect pilot control valve linkages, cables and power takeoff (PTO) controls; adjust, repair or replace as needed [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)

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**

EDU:	12	AD
	I	R

Competency 40.6: Diagnose and repair actuators.

Descriptors:

- 40.6.1 Identify actuator type (e.g., single or double acting, multi-stage or telescopic and motors); determine needed action [P-2].
- 40.6.2 Diagnose the cause of seal failure; determine needed repairs [P-2].
- 40.6.3 Diagnose the cause of incorrect actuator movement and leakage (internal and external); determine needed repairs [P-2].
- 40.6.4 Inspect actuator mounting, frame components and hardware for looseness, cracks and damage; repair or replace as needed [P-2].
- 40.6.5 Remove, repair and/or replace actuators in accordance with manufacturer’s recommended procedures [P-2].
- 40.6.6 Inspect actuators for dents, cracks, damage and leakage; repair or replace as needed [P-2].
- 40.6.7 Purge and/or bleed system in accordance with manufacturer’s recommended procedures [P-1].

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

- *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)

POWER EQUIPMENT TECHNOLOGY

UNITS 41 - 43

Power Equipment Technology

Unit 41: Power Equipment Overview

BIL: Essential

EDU:	12	AD
	P	R

Competency 41.1: Analyze the scope, trends and issues in the power equipment industry.

Descriptors:

- 41.1.1 Present an overview of the power equipment industry.
- 41.1.2 Identify trends and issues that affect the power equipment industry.
- 41.1.3 Identify the professional or trade associations related to the power equipment industry.
- 41.1.4 Identify areas of specialization and related occupations within the power equipment industry.
- 41.1.5 Identify employment opportunities in the power equipment 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)

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)
- *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 41.2: Determine the skills needed to work in the power equipment industry.

Descriptors:

- 41.2.1 Match power equipment career titles with qualifications and responsibilities.
- 41.2.2 Identify the education and training required to work in the various power equipment fields.
- 41.2.3 Describe the kinds of work techniques, processes and procedures a typical power equipment technician might be called upon to perform.

- 41.2.4 Explain the use of flat-rate time.
- 41.2.5 Describe labor rates as they apply to repairs.
- 41.2.6 Obtain certification in appropriate power equipment fields.

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)

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 42: Tools and Equipment

BIL: Essential

EDU:	12	AD
	P	R

Competency 42.1: Identify basic tools and equipment appropriate to power technology.

Descriptors:

- 42.1.1 Identify the various types of tools and equipment applicable for specific operations.
- 42.1.2 Describe the primary functions of various types of hand and power tools.
- 42.1.3 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

EDU:	12	AD
	P	R

Competency 42.2: Utilize test equipment in service operations.

Descriptors:

- 42.2.1 Identify the various pieces of test equipment used in power technology (e.g., volt ohm meter, tachometer, spark tester).
- 42.2.2 Explain the functions of the various test equipment.
- 42.2.3 Demonstrate test equipment applications according to established procedures.

BIL: Essential

EDU:	12	AD
	P	R

Competency 42.3: Demonstrate the appropriate use of basic hand tools to complete work functions.

Descriptors:

- 42.3.1 Identify the potential hazards and limitations related to the use of tools.
- 42.3.2 Demonstrate basic measuring tools (e.g., micrometers).
- 42.3.3 Use tools in accordance with established procedures and safety standards.

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)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 42.4: Operate power tools and stationary equipment.

Descriptors:

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

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 42.5: Maintain hand and power tools appropriate to power technology.

Descriptors:

- 42.5.1 Conduct routine inspections of hand tools and power equipment.
- 42.5.2 Troubleshoot maintenance problems in accordance with established procedures.
- 42.5.3 Perform preventive maintenance in accordance with guidelines specified by the manufacturer and/or outside authorities with jurisdiction (e.g., OSHA).
- 42.5.4 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)
- *Analyze whether graphics supplement textual information and promote the author's purpose.* (Reading: Informational, Technical and Persuasive Text C, 8-10)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 42.6: Use appropriate personal protective equipment (PPE)

Descriptors:

- 42.6.1 Identify the appropriate personal protective equipment (PPE) to wear with specific tasks.
- 42.6.2 Discuss various conditions that workers encounter and match appropriate PPE to each situation.
- 42.6.3 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 43: Service Operations

Note: Throughout Unit 43, students are expected to learn and use vocabulary specific to the power equipment technology 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
	P	R

Competency 43.1: Locate, interpret and utilize parts and service information.

Descriptors:

- 43.1.1 Maintain computer resources.
- 43.1.2 Locate, record and interpret engine and part identification and reference numbers.
- 43.1.3 Use specifications from manual(s) in determining parts analysis decisions.
- 43.1.4 Identify replacement part numbers.
- 43.1.5 Record part numbers and prices on work order.
- 43.1.6 Refer to manufacturers' bulletins.
- 43.1.7 Use a computer to locate part storage locations.
- 43.1.8 Record unit usage hours.

Correlated English Language Arts Academic Content Benchmarks

- *Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 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)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research 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)
- *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

EDU:	12	AD
	I	P

Competency 43.2 Remove and install engines to manufacturer’s technical manual.

Descriptors:

- 43.2.1 Prepare and secure unit for engine removal.
- 43.2.2 Tag and disconnect controls, wires and lines.
- 43.2.3 Secure engine and remove mounting bolts.
- 43.2.4 Remove engine.
- 43.2.5 Reinstall engine in unit.
- 43.2.6 Test engine and make final adjustments.

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)

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.3: Explain four-cycle engine theory.

Descriptors:

- 43.3.1 Identify the components of the four-cycle engine.
- 43.3.2 Describe the function of each component.
- 43.3.3 Explain what is occurring internally through the four cycles.
- 43.3.4 Compare and contrast the four-cycle to the two-cycle engine.

Correlated Mathematics Academic Content Benchmarks

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

Correlated Science Academic Content Benchmarks

- *Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)
- *Describe how atoms and molecules can gain or lose energy only in discrete amounts.* (Physical Sciences C, 11-12)
- *Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.* (Physical Sciences B, 9-10)

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.4: Explain two-cycle engine theory.

Descriptors:

- 43.4.1 Identify the components of the two-cycle engine.
- 43.4.2 Describe the function of each component.
- 43.4.3 Explain what is occurring internally through the cycles.
- 43.4.4 Describe the gasoline – oil ratio and its purpose.
- 43.4.5 Discuss the advantages and disadvantages of the two-cycle engine.

Correlated Mathematics Academic Content Benchmarks

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

Correlated Science Academic Content Benchmarks

- *Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)
- *Describe how atoms and molecules can gain or lose energy only in discrete amounts.* (Physical Sciences C, 11-12)
- *Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.* (Physical Sciences B, 9-10)

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.5: Disassemble, inspect, service and reassemble two-cycle and four-cycle engines to manufacturer’s technical manual.

Descriptors:

- 43.5.1 Disassemble engine and identify parts.
- 43.5.2 Clean and measure parts; analyze for wear.
- 43.5.3 Service, recondition, repair or replace defective parts.
- 43.5.4 Reassemble and test engine.

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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 43.6: Explain basic electrical theory.

Descriptors:

- 43.6.1 Describe the basic methods of using electricity to operate a motor.
- 43.6.2 Describe how mechanical motion causes a generator to produce electrical current.
- 43.6.3 Describe the relationships of voltage, current, resistance and power.
- 43.6.4 Calculate problems using Ohm's Law.
- 43.6.5 Differentiate alternating current (AC) from direct current (DC).
- 43.6.6 Describe the basic types of circuits.
- 43.6.7 Explain how inductance relates to magnetism and describe coil construction, cores and usages.
- 43.6.8 Compare reactance and resistance and describe current-voltage relationships.
- 43.6.9 Calculate power consumption and requirements.

Correlated Mathematics Academic Content Benchmarks

- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 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

- *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 43.7: Explain basic ignition system theory.

Descriptors:

- 43.7.1 Identify the components of a basic ignition system.
- 43.7.2 Describe the different types of ignition systems.
- 43.7.3 Explain the function of each component within the ignition system.

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 43.8: Inspect and service ignition systems.

Descriptors:

- 43.8.1 Inspect and service or replace spark plugs, ignition module systems and all safety switches.
- 43.8.2 Test and analyze battery, electronic and computerized ignition systems.
- 43.8.3 Replace and adjust ignition system components.
- 43.8.4 Inspect and replace safety interlocks and blade-type fuses.
- 43.8.5 Inspect and upgrade to solid-state ignitions.
- 43.8.6 Check for updated parts and service bulletins.

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)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 43.9: Explain carburetion theory.

Descriptors:

- 43.9.1 Identify the components of the carburetor.
- 43.9.2 Describe the function of each component.
- 43.9.3 Explain the scientific principle of carburetion.
- 43.9.4 Explain the impact of pressure difference.

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)
- *Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.* (Physical Sciences B, 9-10)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 43.10: Explain fuel injection theory.

Descriptors:

- 43.10.1 Identify the components of the fuel injection system.
- 43.10.2 Describe the function of each component.
- 43.10.3 Explain the scientific principle of fuel injection.

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)*
- *Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances. (Physical Sciences B, 9-10)*

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 43.11: Explain the composition and inspection of fuels.

Descriptors:

- 43.11.1 Describe the basic composition of gasoline.
- 43.11.2 Explain seasonal alterations to fuel composition.
- 43.11.3 Discuss alterations to fuel compositions for reasons other than weather.
- 43.11.4 Describe the operational impact of improper fuel formulation.
- 43.11.5 Describe the testing procedures for determining fuel composition.

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)*
- *Summarize the historical development of scientific theories and ideas within the study of physical sciences. (Physical Sciences E, 11-12)*
- *Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena. (Physical Sciences A, 11-12)*

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.12: Inspect and service fuel systems.

Descriptors:

- 43.12.1 Inspect and service or repair air cleaners, and reset appropriate service lights.
- 43.12.2 Pressure check carburetor.
- 43.12.3 Inspect fuel system components.
- 43.12.4 Inspect and rebuild carburetors.
- 43.12.5 Service and rebuild fuel transfer pumps and injections pumps.
- 43.12.6 Trace the fuel and airflow of induction systems.
- 43.12.7 Inspect and replace fuel filter.

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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 43.13: Diagnose and repair fuel system.

Descriptors:

- 43.13.1 Check fuel level, quality and consumption.
- 43.13.2 Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply, and return lines and fittings.
- 43.13.3 Inspect, clean and test fuel transfer (lift) pump, pump drives, screens, fuel-water separators and indicators, filters, heaters, coolers, engine control module (ECM), cooling plates and mounting hardware.
- 43.13.4 Inspect and test low-pressure regulator systems, including check valves, pressure regulator valves and restrictive fittings.
- 43.13.5 Check fuel system for air; determine needed action; prime and bleed fuel system.

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)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 43.14: Diagnose and repair mechanical fuel injection.

Descriptors:

- 43.14.1 Perform on-engine inspections, tests and adjustments; check and adjust timing or replace and time a distributor (rotary) type injection pump.
- 43.14.2 Perform on-engine inspections, tests and adjustments; check and adjust timing or replace and time an in-line type injection pump.
- 43.14.3 Inspect and adjust throttle control linkage.
- 43.14.4 Inspect air-to-fuel ratio control systems.
- 43.14.5 Inspect, test and adjust engine fuel shutdown devices and controls.
- 43.14.6 Inspect high-pressure injection lines, hold downs, fittings and seals.

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)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 43.15: Explain alternative fuel systems.

Descriptors:

- 43.15.1 Describe types of alternative fuels.
- 43.15.2 Describe alternative fuel system components.
- 43.15.3 Describe alternative fuel flow.

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: **Essential**

EDU:	12	AD
	P	R

Competency 43.16: Explain turbocharged induction.

Descriptors:

- 43.16.1 Describe the principle of operation for a turbocharger.
- 43.16.2 Identify the components of a turbocharger and describe their functions.
- 43.16.3 Explain the advantages and disadvantages (e.g., reliability, lag).
- 43.16.4 Explain the applications for a turbocharger.

Correlated Science Academic Content Benchmarks

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

Competency 43.17: Explain supercharged induction

Descriptors:

- 43.17.1 Describe the principle of operation for a supercharger.
- 43.17.2 Differentiate the supercharger from the turbocharger.
- 43.17.3 Identify the components of a supercharger and describe their functions.
- 43.17.4 Compare and contrast the advantages and disadvantages of the supercharger versus the turbocharger.
- 43.17.5 Explain the applications for a supercharger.

Correlated Science Academic Content Benchmarks

- *Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 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 43.18: Inspect and service governor systems.

Descriptors:

- 43.18.1 Describe the function of the governor system.
- 43.18.2 Identify the components of the governor system and describe their functions.
- 43.18.3 Inspect, repair and adjust all electronic, linkage, springs, bellcranks and diaphragm speed-control components.
- 43.18.4 Adjust speed-controlling devices according to manufacturer’s specifications.
- 43.18.5 Test unit with an actual or simulated load.

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

- *Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- *Apply indirect measurement techniques, tools and formulas, as appropriate, to find perimeter, circumference and area of circles, triangles, quadrilaterals and composite shapes, and to find volume of prisms, cylinders, and pyramids.* (Measurement C, 8-10)
- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 43.19: Explain the composition of the various oils used for lubrication.

Descriptors:

- 43.19.1 Identify the basic oils used in the power technology industry.
- 43.19.2 Explain the distinguishing features of each oil composition.
- 43.19.3 Explain the labeling system used to identify the various compositions.

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)
- *Summarize the historical development of scientific theories and ideas within the study of physical sciences.* (Physical Sciences E, 11-12)
- *Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.* (Physical Sciences A, 11-12)

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.20: Inspect and service lubrication systems to manufacturer’s specifications.

Descriptors:

- 43.20.1 Describe the function of the lubrication system.
- 43.20.2 Identify the component parts of the lubrication system, and describe their functions.
- 43.20.3 Change oil and filter.
- 43.20.4 Inspect and service crankcase breathers.
- 43.20.5 Service or repair oil pumps, screens, lines and splashers.
- 43.20.6 Inspect and service internal lubrication components.
- 43.20.7 Select, store and dispose of oil and lubricants in accordance with federal and state regulations.

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

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

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.21: Describe the function and operation of the cooling system.

Descriptors:

- 43.21.1 Identify the different types and applications of coolants.
- 43.21.2 Describe the components of the cooling system.
- 43.21.3 Explain the function of each component.
- 43.21.4 Describe the scientific principle of a cooling system.

Correlated Science Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.22: Inspect and service cooling systems.

Descriptors:

- 43.22.1 Remove shroud and clean fins and housing.
- 43.22.2 Conduct pressure and coolant tests on liquid-cooled engines.
- 43.22.3 Check and replace thermostats, fans and radiators.
- 43.22.4 Inspect and repair or replace water pumps, lines and connections.
- 43.22.5 Perform seasonal service on cooling systems.
- 43.22.6 Check system operation and clean radiator.
- 43.22.7 Store coolant and other cooling system chemicals in designated area and in accordance with federal and state regulations.

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

- *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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 43.23: Inspect and service lighting, accessory and charging systems.

Descriptors:

- 43.23.1 Read and interpret schematics.
- 43.23.2 Trace current flow of electrical systems.
- 43.23.3 Conduct voltage, current, resistance, charging, alternator and load tests.
- 43.23.4 Replace or service defective components.
- 43.23.5 Utilize electrical troubleshooting techniques.

Correlated English Language Arts Academic Content Benchmarks

- *Analyze whether graphics supplement textual information and promote the author’s purpose.* (Reading: Informational, Technical and Persuasive Text C, 8-10)

Correlated Mathematics Academic Content Benchmarks

- *Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 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)
- *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
	P	R

Competency 43.24: **Inspect and service batteries.**

Descriptors:

- 43.24.1 Identify the different types of batteries (e.g., deep cycle, solid state, maintenance free, regular).
- 43.24.2 Describe the maintenance requirements for each type of battery.
- 43.24.3 Perform battery test procedures.

Correlated Mathematics Academic Content Benchmarks

- *Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 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)

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.25: Perform gas and diesel engine tune-up.

Descriptors:

- 43.25.1 Change engine oil filter and oil.
- 43.25.2 Change engine air filters.
- 43.25.3 Change fuel filters.
- 43.25.4 Demonstrate the appropriate calculations necessary to perform tune-ups.

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

EDU:	12	AD
	I	P

Competency 43.26: Analyze the various power takeoff (PTO) accessories.

Descriptors:

- 43.26.1 Identify the various PTO accessories and describe their functions.
- 43.26.2 Explain the principle of transferring power to accessories.
- 43.26.3 Compare load ratios between size of engine and power needs of accessories.
- 43.26.4 Describe the special safety precautions attributed to PTOs.

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)

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)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 43.27: Inspect and adjust power takeoff (PTO) accessories.

Descriptors:

- 43.27.1 Install PTO accessories.
- 43.27.2 Adjust PTO clutches and drive trains.
- 43.27.3 Inspect and replace damaged or missing PTO shields.
- 43.27.4 Inspect and replace universal joints and keepers.

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)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 43.28: Analyze the operational features of motion drive systems.

Descriptors:

- 43.28.1 Explain the principle of motion drive systems.
- 43.28.2 Identify the component parts of motion drive systems, and describe their functions.
- 43.28.3 Describe the basic power needs of various motion drive systems.

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)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 43.29: Inspect and service motion drive systems.

Descriptors:

- 43.29.1 Inspect, service and repair manual, fluid and electromagnetic clutches.
- 43.29.2 Inspect, service, and repair belt, shaft and chain drive devices.
- 43.29.3 Remove and replace motion drive system.
- 43.29.4 Disassemble, inspect and reassemble transmissions, transaxles, transmissions and differentials.
- 43.29.5 Inspect, service and repair hydraulic and pneumatic drives.
- 43.29.6 Inspect and test all safety switches.

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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 43.30: Analyze the operational features of frame, suspension and steering systems

Descriptors:

- 43.30.1 Describe the structural design of various power technology frames.
- 43.30.2 Explain the designs of various suspension systems.
- 43.30.3 Identify the components of the steering systems, and describe their function.
- 43.30.4 Discuss the potential weaknesses of frame, suspension and steering systems.

BIL: Essential

EDU:	12	AD
	I	P

Competency 43.31: Inspect and service frame, suspension and steering systems.

Descriptors:

- 43.31.1 Inspect the components of frame, suspension and steering systems for wear or damage.
- 43.31.2 Service or repair worn components (e.g. tie rods, drag link and steering gears).
- 43.31.3 Check frame and suspension systems for proper alignment and trueness.

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)

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.32: Inspect and service tires, wheels and brakes.

Descriptors:

- 43.32.1 Adjust tow-in; check for and replace broken or bent rims..
- 43.32.2 Balance wheels.

- 43.32.3 Inflate tires to specified pressure.
- 43.32.4 Remove, repair or replace tubes and tubeless tires.
- 43.32.5 Describe the braking principles for power technology equipment.
- 43.32.6 Inspect, service, recondition, adjust or replace brakes as needed.

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)

BIL: Essential

EDU:	12	AD
	P	R

Competency 43.33: Service multi-cylinder engines to manufacturer’s specifications.

Descriptors:

- 43.33.1 Identify types of engines.
- 43.33.2 Determine engine operational sequence.
- 43.33.3 Adjust valve train components.
- 43.33.4 Set timing.
- 43.33.5 Adjust carburetor.
- 43.33.6 Run cylinder leak-down and compression tests.
- 43.33.7 Inspect and adjust fuel pump pressure.
- 43.33.8 Inspect and replace fuel injectors as needed.

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

- *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)

BIL: **Essential**

EDU:	12	AD
	P	R

Competency 43.34: Perform equipment maintenance and storage to manufacturer’s specifications.

Descriptors:

- 43.34.1 Drain and clean fuel system components.
- 43.34.2 Remove, clean, inspect, sharpen and balance cutting blades.
- 43.34.3 Re-torque mounting bolts or nuts.
- 43.34.4 Check wheel bearings, spindle bearings, belts and idler pulley on deck.
- 43.34.5 Apply grease to tractor and deck.
- 43.34.6 Service batteries.
- 43.34.7 Check and adjust air pressure in tires.
- 43.34.8 Clean, repair and paint decks, frames, and sheet metal covers and shrouds.
- 43.34.9 Prepare unit for off-season storage.
- 43.34.10 Add fuel stabilizer.

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

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

BIL: **Recommended**

EDU:	12	AD
	I	P

Competency 43.35: Demonstrate welding, soldering and heat-treating operations.

Descriptors:

- 43.35.1 Set up and complete oxyacetylene welding, brazing and cutting operations.
- 43.35.2 Solder with propane torch, soldering gun or soldering iron.
- 43.35.3 Set up and complete arc welding operations.
- 43.35.4 Set up and complete metal inert gas (MIG) welding operations.
- 43.35.5 Set up and complete tungsten inert gas (TIG) welding operations.

Correlated Mathematics Academic Content Benchmarks

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

AIR TRANSPORTATION PATHWAY

UNITS 44 - 63

AVIATION MAINTENANCE TECHNICIAN

UNITS 44 - 49

Aviation Maintenance Technician

Federal Aviation Administration (FAA) Part 147 – Curriculum Requirements

Level 1 requires:

*Knowledge of general principles, but no practical application
No development of manipulative skill*

Level 2 requires:

*Knowledge of general principles, and limited practical application
Development of sufficient manipulative skill to perform basic operations*

Level 3 requires:

*Knowledge of general principles, and performance of high degree of practical application
Development of sufficient manipulative skills to simulate return to service*

Unit 44: Orientation to Aviation Maintenance

BIL: Essential

EDU:	12	AD
	I	P

Competency 44.1: Analyze the scope, trends and issues in the aviation industry.

Descriptors:

- 44.1.1 Present an overview of the aviation industry.
- 44.1.2 Identify trends and issues that affect the industry.
- 44.1.3 Identify the professional and/or trade associations related to the aviation industry.
- 44.1.4 Identify areas of specialization and related occupations within the industry.
- 44.1.5 Identify the employment opportunities in the aviation 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)

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)

- *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

EDU:	12	AD
	I	P

Competency 44.2: Determine the skills needed to work in the aviation industry.

Descriptors:

- 44.2.1 Match aviation occupational job titles with qualifications and responsibilities.
- 44.2.2 Identify the education, training and certification required to work in the various aviation careers.
- 44.2.3 Describe the kinds of work techniques, processes and procedures a typical aviation employee might be called upon to perform.

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)

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)

Unit 45: General Aviation

BIL: Essential

EDU:	12	AD
	I	P

Competency 45.1: Assess basic electricity concepts.

Descriptors:

- 45.1.1 Calculate and measure capacitance and inductance (2).
- 45.1.2 Calculate and measure electrical power (2).
- 45.1.3 Measure voltage, current, resistance and continuity (3).
- 45.1.4 Determine the relationship of voltage, current and resistance in electrical circuits (3).
- 45.1.5 Read and interpret aircraft electrical circuit diagrams, including solid state devices and logic functions (3).
- 45.1.6 Inspect and service batteries (3).

Correlated English Language Arts Academic Content Benchmarks

- *Analyze whether graphics supplement textual information and promote the author's purpose.* (Reading: Informational, Technical and Persuasive Text C, 8-10)

Correlated Mathematics Academic Content Benchmarks

- *Connect physical, verbal and symbolic representations of integers, rational numbers and irrational numbers.* (Number, Number Sense and Operations D, 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, compute and solve problems involving scientific notation, square roots and numbers with integer exponents.* (Number, Number Sense and Operations I, 8-10)
- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *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)
- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)
- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 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)
- *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 45.2: Utilize aircraft drawings.

Descriptors:

- 45.2.1 Use aircraft drawings, symbols and system schematics (2).
- 45.2.2 Draw sketches of repairs and alterations (3).
- 45.2.3 Use blueprint information (3).
- 45.2.4 Use graphs and charts (3).

Correlated English Language Arts Academic Content Benchmarks

- *Analyze whether graphics supplement textual information and promote the author’s purpose.* (Reading: Informational, Technical and Persuasive Text C, 8-10)

Correlated Mathematics Academic Content Benchmarks

- *Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.* (Geometry and Spatial Sense C, 8-10)
- *Use coordinate geometry to represent and examine the properties of geometric figures.* (Geometry and Spatial Sense D, 8-10)
- *Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology.* (Geometry and Spatial Sense E, 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)
- *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)

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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 45.3: Assess weight and balance.

Descriptors:

- 45.3.1 Weight aircraft (2).
- 45.3.2 Perform a complete weight-and-balance check and record data (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)
- *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)
- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 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 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 45.4: Fabricate fluid lines and fittings.

Descriptors:

- 45.4.1 Fabricate and install rigid and flexible fluid lines and fittings (3).
- 45.4.2 Select the proper fittings according to the application.
- 45.4.3 Determine the airworthiness of a given line.

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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 45.5: Evaluate materials and perform processes.

Descriptors:

- 45.5.1 Identify and select appropriate, nondestructive testing methods (1).
- 45.5.2 Perform dye penetrant, eddy current, ultrasonic and magnetic particle inspections (2).
- 45.5.3 Perform basic heat-treating processes (1).
- 45.5.4 Identify and select aircraft hardware and materials (3).
- 45.5.5 Inspect and check welds (3).
- 45.5.6 Perform precision measurements (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)
- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 45.6: Demonstrate ground operation and servicing.

Descriptors:

- 45.6.1 Start, ground operate, move, service and secure aircraft, and identify typical ground operation (2).
- 45.6.2 Identify and select fuels (2).
- 45.6.3 Identify proper ground servicing equipment.
- 45.6.4 Identify runway incursions and markings.
- 45.6.5 Demonstrate standard radio and hand communication procedures.

BIL: Essential

EDU:	12	AD
	I	P

Competency 45.7: Demonstrate cleaning and corrosion control.

Descriptors:

45.7.1 Identify and select cleaning materials (3).

45.7.2 Inspect, identify, remove and treat aircraft corrosion, and perform aircraft cleaning (3).

BIL: Essential

EDU:	12	AD
	P	R

Competency 45.8: Integrate mathematics.

Descriptors:

45.8.1 Extract roots and raise numbers to a given power (3).

45.8.2 Determine the areas and volumes of various geometrical shapes (3).

45.8.3 Solve ratio, proportion and percentage problems (3).

45.8.4 Perform algebraic operations involving addition, subtraction, multiplication and division of positive and negative numbers (3).

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)
- *Find the square root of perfect squares, and approximate the square root of non-perfect squares.* (Number, Number Sense and Operations H, 8-10)
- *Estimate, compute and solve problems involving scientific notation, square roots and numbers with integer exponents.* (Number, Number Sense and Operations I, 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)
- *Use coordinate geometry to represent and examine the properties of geometric figures.* (Geometry and Spatial Sense D, 8-10)
- *Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology.* (Geometry and Spatial Sense E, 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)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 45.9: Complete maintenance forms and records.

Descriptors:

- 45.9.1 Write descriptions of work performed, including aircraft discrepancies and corrective actions using typical aircraft maintenance records (3).
- 45.9.2 Complete required maintenance forms, records and inspection reports (3).

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)

Correlated Mathematics Academic Content Benchmarks

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

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 45.10: Utilize basic physics.

Descriptors:

- 45.10.1 Explain the principles of simple machines; sound, fluid and heat dynamics; basic aerodynamics; aircraft structure; and theory of flight (2).
- 45.10.2 Employ the principles of simple machines (2).

Correlated Science Academic Content Benchmarks

- *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 45.11: Utilize maintenance publications.

Descriptors:

- 45.11.1 Demonstrate the ability to read, comprehend and apply information contained in FAA and manufacturer's aircraft maintenance specifications, data sheets, manuals, publications and related federal aviation regulations, airworthiness directives and advisory material (3).
- 45.11.2 Read technical data (3).

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)
- *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

- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Use a variety of mathematical representations flexibly and appropriately to organize, record and communicate mathematical ideas.* (Mathematical Processes E, 8-10)

BIL: Essential

EDU:	12	AD
	I	P

Competency 45.12: Exercise mechanics' privileges and limitations.

Descriptors:

- 45.12.1 Exercise mechanics' privileges within the limitations prescribed by Part 65 of this chapter (FAR 147) (3).
- 45.12.2 Explain the knowledge, skill, experience and requirements to exercise the privileges of the aviation mechanic.

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)

Unit 46: Airframe Structures

This unit may not be applicable to a power plant-only certified school.

BIL: Essential

EDU:	12	AD
	I	P

Competency 46.1: Perform wood structure maintenance.

Descriptors:

- 46.1.1 Service and repair wood structures (1).
- 46.1.2 Identify wood defects (1).
- 46.1.3 Inspect wood structures (1).

BIL: Essential

EDU:	12	AD
	I	P

Competency 46.2: Perform aircraft covering maintenance.

Descriptors:

- 46.2.1 Select and apply fabric and fiberglass covering materials (1).
- 46.2.2 Inspect, test and repair fabric and fiberglass (1).

Correlated Mathematics Academic Content Benchmarks

- *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)*

BIL: Essential

EDU:	12	AD
	I	P

Competency 46.3: Apply aircraft finishes.

Descriptors:

- 46.3.1 Demonstrate proper surface preparation.
- 46.3.2 Apply trim, letters and touchup paint (1).
- 46.3.3 Identify and select aircraft finishing materials (2).
- 46.3.4 Apply finishing materials (2).
- 46.3.5 Inspect finishes and identify defects (2).

Correlated Mathematics Academic Content Benchmarks

- *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)*

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 46.4: Evaluate and repair sheet metal and non-metallic structures.

Descriptors:

- 46.4.1 Select, install and remove special fasteners for metallic, bonded and composite structures (2).
- 46.4.2 Inspect bonded structures (2).
- 46.4.3 Inspect, test and repair fiberglass, plastics, honeycomb, composite and laminated primary and secondary structures (2).
- 46.4.4 Inspect, check, service and repair windows, doors and interior furnishings (2).
- 46.4.5 Inspect and repair sheet metal structures (3).
- 46.4.6 Install conventional rivets (3).
- 46.4.7 Form, layout and bend sheet metal (3).

Correlated Mathematics Academic Content Benchmarks

- *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)*

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 46.5: Demonstrate welding operations.

Descriptors:

- 46.5.1 Weld magnesium and titanium (1).
- 46.5.2 Solder stainless steel (1).
- 46.5.3 Fabricate tubular structures (1).
- 46.5.4 Solder, braze, gas-weld and arc-weld steel (2).
- 46.5.5 Weld aluminum and stainless steel (1).

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)*

BIL: Essential

EDU:	12	AD
	I	P

Competency 46.6: Demonstrate assembly and rigging operations.

Descriptors:

- 46.6.1 Rig rotary-wing aircraft (1).
- 46.6.2 Rig fixed-wing aircraft (2).
- 46.6.3 Check alignment of structures (2).
- 46.6.4 Assemble aircraft components, including flight control surfaces (3).
- 46.6.5 Balance, rig and inspect movable primary and secondary flight control surfaces (3).
- 46.6.6 Jack aircraft (3).

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)*

BIL: Essential

EDU:	12	AD
	I	P

Competency 46.7: Complete airframe inspection.

Descriptors:

- 46.7.1 Perform airframe conformity and airworthiness inspections (3).
- 46.7.2 Determine the airworthiness inspection requirements for a particular aircraft.
- 46.7.3 Describe the application of an aging aircraft in relation to its airworthiness status.

Correlated Mathematics Academic Content Benchmarks

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

Unit 47: Airframe Systems and Components

This unit may not be applicable to a power plant-only certified school.

BIL: Essential

EDU:	12	AD
	I	P

Competency 47.1: Evaluate and repair aircraft landing gear systems.

Descriptors:

- 47.1.1 Inspect and check landing gear, retraction systems, shock struts, brakes, wheels, tires and steering systems (3).
- 47.1.2 Service and repair landing gear, retraction systems, shock struts, brakes, wheels, tires and steering systems (3).

Correlated Mathematics Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 47.2: Evaluate and repair hydraulic and pneumatic power systems.

Descriptors:

- 47.2.1 Repair hydraulic and pneumatic power systems components (2).
- 47.2.2 Identify and select hydraulic fluids (3).
- 47.2.3 Inspect, check, service, troubleshoot and repair hydraulic and pneumatic power systems (3).
- 47.2.4 Interpret hydraulic systems schematics.
- 47.2.5 Identify the basic hydraulic and pneumatic principles and components.

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 47.3: Evaluate and service cabin atmosphere control systems.

Descriptors:

- 47.3.1 Inspect, check, troubleshoot, service and repair heating, cooling, air conditioning, pressurization systems and air cycle machines (1).
- 47.3.2 Inspect, check, troubleshoot, service and repair heating, cooling, air conditioning and pressurization systems (1).
- 47.3.3 Inspect, check, troubleshoot, service and repair oxygen systems (2).
- 47.3.4 Identify the basic cabin atmosphere principles and components.

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 47.4: Troubleshoot and repair aircraft instrument systems.

Descriptors:

- 47.4.1 Inspect, check, service, troubleshoot and repair electronic flight instrument systems and both mechanical and electrical heading, speed, altitude, temperature, pressure and position indicating systems, including the use of built-in test equipment (1).
- 47.4.2 Install instruments and perform a static pressure system leak test (2).
- 47.4.3 Explain the mechanics of privileges and limitations associated with aircraft instrument systems.

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: Essential

EDU:	12	AD
	I	P

Competency 47.5: Evaluate and repair communication and navigation systems.

Descriptors:

- 47.5.1 Explain the mechanics of privileges and limitations associated with aircraft instrument systems.
- 47.5.2 Inspect, check and troubleshoot autopilot, servos and approach coupling systems (1).
- 47.5.3 Inspect, check and service aircraft electronic communication and navigation systems, including very high frequency (VHF) passenger address interphones and static discharge devices, aircraft VHF omni-directional range navigation system (VOR), instrument landing system (ILS), long range aid to navigation (LORAN), radar beacon transponders, flight management computers and ground proximity warning system (GPWS) (1).
- 47.5.4 Inspect and repair antenna and electronic equipment installations (2).

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: Essential

EDU:	12	AD
	I	P

Competency 47.6: Evaluate and service aircraft fuel systems.

Descriptors:

- 47.6.1 Check and service fuel dump systems (1).
- 47.6.2 Perform fuel management transfer and defueling (1).
- 47.6.3 Inspect, check and repair pressure fueling systems (1).
- 47.6.4 Repair aircraft fuel system components (2).
- 47.6.5 Inspect and repair fluid quantity indicating systems (2).
- 47.6.6 Troubleshoot, service and repair fluid pressure and temperature warning system (2).
- 47.6.7 Inspect, check, service, troubleshoot and repair aircraft fuel systems (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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 47.7: Evaluate and service aircraft electrical systems.

Descriptors:

- 47.7.1 Repair and inspect aircraft electrical system components; crimp and splice wiring to manufacturer's specifications; and repair pins and sockets of aircraft connectors (2).
- 47.7.2 Install, check and service airframe electrical wiring, controls, switches, indicators and protective devices (3).
- 47.7.3 Inspect, check, troubleshoot, service and repair alternating and direct current electrical systems (3).
- 47.7.4 Inspect, check and troubleshoot constant speed and integrated speed drive generators (1).

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

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

EDU:	12	AD
	I	P

Competency 47.8: Evaluate and service position and warning systems.

Descriptors:

- 47.8.1 Inspect, check and service speed and configuration warning systems, electrical brake controls and anti-skid systems (2).
- 47.8.2 Inspect, check, troubleshoot and service landing gear position indicator and warning systems (3).

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 47.9: Evaluate and service ice and rain control systems.

Descriptors:

- 47.9.1 Inspect, check and troubleshoot airframe ice and rain control systems (2).
- 47.9.2 Service and repair airframe ice and rain control systems (2).
- 47.9.3 Describe operations of typical anti-icing and de-icing systems.
- 47.9.4 Demonstrate preventative maintenance for typical anti-icing and de-icing systems.

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 47.10: Evaluate and service fire protection systems.

Descriptors:

- 47.10.1 Inspect, check and service smoke and carbon monoxide detection systems (1).
- 47.10.2 Inspect, check, service, troubleshoot and repair aircraft fire detection and extinguishing systems (3).

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 47.11: Describe avionic systems.

Descriptors:

- 47.11.1 Define an avionic system.
- 47.11.2 Identify the components of an avionic system.
- 47.11.3 Describe the functions of avionic system components.

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)

Unit 48: Powerplant Theory and Maintenance

This unit may not be applicable to an airframe-only certified school.

BIL: Essential

EDU:	12	AD
	I	P

Competency 48.1: Evaluate and service reciprocating engines.

Descriptors:

- 48.1.1 Explain reciprocating two- and four-cycle engine theory.
- 48.1.2 Explain diesel engine theory.
- 48.1.3 Inspect and repair a radial engine (1).
- 48.1.4 Overhaul a reciprocating engine (2).
- 48.1.5 Inspect, check, service and repair reciprocating engines and engine installations (3).
- 48.1.6 Install, troubleshoot and remove reciprocating engines (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)

BIL: Essential

EDU:	12	AD
	I	P

Correlated Science Academic Content Benchmarks

- *Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)
- *Describe how atoms and molecules can gain or lose energy only in discrete amounts.* (Physical Sciences C, 11-12)

Competency 48.2: Evaluate and service turbine engines.

Descriptors:

- 48.2.1 Explain turbine engine theory (e.g., propulsion, turbo prop, turbo jet, turbo fan).
- 48.2.2 Overhaul a turbine engine (2).
- 48.2.3 Inspect, check, service and repair turbine engines and turbine engine installations (3).
- 48.2.4 Install, troubleshoot and remove turbine engines (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)

Correlated Science Academic Content Benchmarks

- *Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 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 48.3: Complete engine inspection.

Descriptors:

- 48.3.1 Perform powerplant conformity and airworthiness inspections (3).
- 48.3.2 Determine airworthiness of engines.
- 48.3.3 Describe types of inspections required for continued airworthiness.

Correlated Mathematics Academic Content Benchmarks

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

Unit 49: Powerplant Systems and Components

This unit may not be applicable to an airframe-only certified school.

BIL: Essential

EDU:	12	AD
	I	P

Competency 49.1: Evaluate and service engine instrument systems.

Descriptors:

- 49.1.1 Troubleshoot, service and repair electrical and mechanical fluid rate-of-flow indicating systems.
- 49.1.2 Inspect, check, service, troubleshoot and repair electrical and mechanical engine temperature, pressure and r.p.m. indicating systems (3).
- 49.1.3 Explain the mechanics of privileges and limitations associated with engine instrument systems.

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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 49.2: Evaluate and service engine fire protection systems.

Descriptors:

- 49.2.1 Inspect, check, service, troubleshoot and repair engine fire detection and extinguishing systems (3).
- 49.2.2 Determine airworthiness of engine fire protection systems.

Correlated Mathematics Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 49.3: Evaluate and service engine electrical systems.

Descriptors:

- 49.3.1 Repair engine electrical system components (2).
- 49.3.2 Install, check and service engine electrical wiring, controls, switches, indicators and protective devices (3).

BIL: Essential

EDU:	12	AD
	I	P

Competency 49.4: Evaluate and service lubrication systems.

Descriptors:

- 49.4.1 Identify and select lubricants (2).
- 49.4.2 Repair engine lubrication system components (2).
- 49.4.3 Inspect, check, service, troubleshoot and repair engine lubrication systems (3).

Correlated Mathematics Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 49.5: Evaluate and service ignition and starting systems.

Descriptors:

- 49.5.1 Explain ignition and starting systems theory.
- 49.5.2 Overhaul magneto and ignition harness (2).
- 49.5.3 Inspect, service, troubleshoot and repair reciprocating and turbine engine ignition systems and components (2).
- 49.5.4 Inspect, service, troubleshoot and repair turbine engine electrical starting systems (3).
- 49.5.5 Inspect, service and troubleshoot turbine engine pneumatic starting systems (1).

Correlated Mathematics Academic Content Benchmarks

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

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 49.6: Evaluate and service fuel metering systems.

Descriptors:

- 49.6.1 Describe fuel metering system theory.
- 49.6.2 Troubleshoot and adjust turbine engine fuel metering systems and electronic engine fuel controls (1).
- 49.6.3 Overhaul carburetor (2).
- 49.6.4 Repair engine fuel metering systems components (2).
- 49.6.5 Inspect, check, service, troubleshoot and repair reciprocating and turbine engine fuel metering systems (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)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 49.7: Evaluate and service engine fuel systems.

Descriptors:

- 49.7.1 Describe engine fuel system theory.
- 49.7.2 Repair engine fuel system components (2).
- 49.7.3 Inspect, check, service, troubleshoot and repair engine fuel systems (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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 49.8: Evaluate and service induction and engine airflow systems.

Descriptors:

- 49.8.1 Describe induction and engine airflow system theory.
- 49.8.2 Inspect, check, troubleshoot, service and repair engine ice and rain control systems (2).
- 49.8.3 Inspect, check, service, troubleshoot and repair heat exchangers, superchargers and turbine engine airflow and temperature control systems (1).
- 49.8.4 Inspect, check, service and repair carburetor air intake and induction manifolds (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)

Correlated Science Academic Content Benchmarks

- *Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 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 49.9: Evaluate and service engine cooling systems.

Descriptors:

- 49.9.1 Repair engine cooling system components (2).
- 49.9.2 Inspect, check, troubleshoot, service and repair engine cooling systems (3).

Correlated Mathematics Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 49.10: Evaluate and service engine exhaust and reverser systems.

Descriptors:

- 49.10.1 Repair engine exhaust system components (2).
- 49.10.2 Inspect, check, troubleshoot, service and repair engine exhaust systems (3).
- 49.10.3 Troubleshoot and repair engine thrust reverser systems and related components (1).

Correlated Mathematics Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 49.11: Evaluate and service propellers.

Descriptors:

- 49.11.1 Describe propeller theory and operation.
- 49.11.2 Inspect, check, service and repair propeller synchronizing and ice control systems (1).
- 49.11.3 Identify and select propeller lubricants (2).
- 49.11.4 Balance propellers (1).
- 49.11.5 Repair propeller control system components (2).
- 49.11.6 Inspect, check, service and repair fixed-pitch, constant-speed and feathering propellers and propeller governing systems (3).
- 49.11.7 Install, troubleshoot and remove propellers (3).
- 49.11.8 Repair aluminum alloy propeller blades (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)

Correlated Science Academic Content Benchmarks

- *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 49.12: Inspect and troubleshoot unducted fan systems and components (1).

Descriptors:

- 49.12.1 Identify fan systems and components.
- 49.12.2 Describe the function of fan systems and components.

Correlated Mathematics Academic Content Benchmarks

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

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 49.13: Assess auxiliary power unit.

Descriptors:

- 49.13.1 Inspect, check, service and troubleshoot turbine-driven auxiliary power units.
- 49.13.2 Identify auxiliary power unit components.

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)

AVIATION TECHNOLOGY

UNITS 50 - 63

Aviation Technology

Unit 50: Overview

BIL: Recommended

EDU:	12	AD
	I	R

Competency 50.1: Explain the historical evolution of air transportation.

Descriptors:

- 50.1.1 Trace air technology from its inception to the current industry.
- 50.1.2 Describe the major contributors and barriers to air transportation development.
- 50.1.3 Discuss the current trends and issues impacting air transportation.

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)

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)
- *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
	I	P

Competency 50.2: Explain the structure of the air transportation industry.

Descriptors:

- 50.2.1 Identify the elements of the industry that contribute to the movement of people and goods.
- 50.2.2 Describe the function of each of those elements.
- 50.2.3 Describe the collaboration necessary within the industry.
- 50.2.4 Discuss the role of international air transportation.
- 50.2.5 Examine the growth and future of the 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)

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)
- *Use a variety of mathematical representations flexibly and appropriately to organize, record and communicate mathematical ideas.* (Mathematical Processes E, 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 50.3 **Examine the numerous careers and respective training for the air transportation industry.**

Descriptors:

- 50.3.1 Identify current and future career options.
- 50.3.2 Describe the education and training necessary for each of the career options.
- 50.3.3 Identify licenses, certifications, credentials and ratings applicable to specific careers.
- 50.3.4 Identify personal characteristics required of individuals working in the field.
- 50.3.5 Describe the impact the military can have on career preparation.

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)
- *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
	I	P

Competency 50.4: Identify the various aerospace organizations.

Descriptors:

- 50.4.1 Trace the evolution of the Federal Aviation Administration (FAA).
- 50.4.2 Discuss various aspects of the governmental controlling agencies (FAA, International Civil Aviation Organization [ICAO], National Transportation Safety Board [NTSB]), and describe their functions.
- 50.4.3 Describe the purpose of the National Aeronautics and Space Administration (NASA).
- 50.4.4 Identify other aerospace organizations and describe their functions.

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: Recommended

EDU:	12	AD
	I	R

Competency 50.5: Examine the regulatory framework of aviation.

Descriptors:

- 50.5.1 Describe the early legislation that shaped the airline industry.
- 50.5.2 Describe the major legislative acts that have impacted aviation.
- 50.5.3 Discuss the impact of airline deregulation.

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

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

Unit 51: Types of Aviation

BIL: Recommended

EDU:	12	AD
	I	P

Competency 51.1: Examine the aspects of general aviation.

Descriptors:

- 51.1.1 Define general aviation and identify the FAA primary use categories.
- 51.1.2 Identify the various constituents who travel by air, and describe their reasons for traveling by air.
- 51.1.3 Discuss the advantages and disadvantages of each classification (e.g., corporate, business, coach).

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

BIL: Recommended

EDU:	12	AD
	I	P

Competency 51.2: Identify the aspects of commercial aviation.

Descriptors:

- 51.2.1 Identify the various commercial carriers.
- 51.2.2 Describe the function of each carrier, and discuss the distinctions that make them different from other carriers.

Correlated English Language Arts Academic Content Benchmarks

- *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)

BIL: Recommended

EDU:	12	AD
	I	P

Competency 51.3: Examine the aspects of military aviation

Descriptors:

- 51.3.1 Describe the functions of the major categories of military aircraft.
- 51.3.2 Discuss recent innovations in military aircraft.
- 51.3.3 Explain the impacts of wars and international conflicts on the air transportation industry.
- 51.3.4 Explain what makes air power unique.

Correlated English Language Arts Academic Content Benchmarks

- *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)

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

BIL: Recommended

EDU:	12	AD
	I	P

Competency 51.4: Identify fixed base operators and their role in general aviation.

Descriptors:

- 51.4.1 Define the fixed base operator's function.
- 51.4.2 Describe typical services provided by fixed base operators.
- 51.4.3 Identify the fixed base operator's role in sales and training.
- 51.4.4 Discuss the current trends and issues impacting fixed base operations.

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)
- *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 51.5: **Explain business and commercial aviation.**

Descriptors:

- 51.5.1 Distinguish business from commercial aviation.
51.5.2 Describe the typical business traveler.
51.5.3 Identify common aircraft for business travel.
51.5.4 Describe non-transportation areas of commercial aviation.

BIL: **Recommended**

EDU:	12	AD
	I	P

Competency 51.6: **Explain the use of helicopters.**

Descriptors:

- 51.6.1 Describe the operating principles of helicopter flight.
51.6.2 Discuss the various domestic uses for helicopters.
51.6.3 Describe the various military uses for helicopters.

Correlated Science Academic Content Benchmarks

- *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: **Recommended**

EDU:	12	AD
	I	P

Competency 51.7: **Explain the evolution of jet transportation.**

Descriptors:

- 51.7.1 Identify the technology that spurred the development of jet transports.
51.7.2 Discuss the development of the jet engine.
51.7.3 Describe qualities of jet transports (e.g., high lift systems, stopping systems, environmental changes).

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)
- *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 52: Aircraft Systems and Technology

BIL: Essential

EDU:	12	AD
	I	P

Competency 52.1: Describe the powerplant and related systems.

Descriptors:

- 52.1.1 Identify the major types of aircraft engines.
- 52.1.2 Describe the types of fuel and oil systems.
- 52.1.3 Describe how the cooling system functions.
- 52.1.4 Describe how the exhaust system functions.
- 52.1.5 Identify major components of the electrical system.
- 52.1.6 Describe the function of the aircraft hydraulic system.
- 52.1.7 Identify the major types of landing gears, and explain how they function.

Correlated Science Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 52.2: Examine the aircraft instruments.

Descriptors:

- 52.2.1 Identify each flight instrument and describe its function.
- 52.2.2 Describe variation, deviation and magnetic dip.

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)

Unit 53: Airport Environment

BIL: Essential

EDU:	12	AD
	I	P

Competency 53.1: Examine the national airport network.

Descriptors:

- 53.1.1 Identify the different types of airports within the United States.
- 53.1.2 Distinguish between controlled and uncontrolled airports.
- 53.1.3 Describe the hub system and its impact on domestic transportation.

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: Essential

EDU:	12	AD
	I	P

Competency 53.2: Explain airport design.

Descriptors:

- 53.2.1 Explain basic airport design, traffic patterns and runway markings.
- 53.2.2 Identify the various lighting systems and explain their functions.
- 53.2.3 Describe instruments designed to indicate wind variations.
- 53.2.4 Discuss strategies and procedures employed to control and modify noise.

Correlated English Language Arts Academic Content Benchmarks

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

Unit 54: Air Traffic Control and Communication

BIL: Essential

EDU:	12	AD
	I	P

Competency 54.1: Explore sources for air traffic control (ATC) information.

Descriptors:

- 54.1.1 Identify the various sources of flight information.
- 54.1.2 Describe the information provided from each source.

BIL: Essential

EDU:	12	AD
	I	P

Competency 54.2: Analyze radar and ATC services.

Descriptors:

- 54.2.1 Explain the principles of radar.
- 54.2.2 Describe how a transponder works.
- 54.2.3 Identify the various codes.
- 54.2.4 Identify different types of FAA radar systems and describe their respective services.
- 54.2.5 Explain automatic terminal information system (ATIS) and traffic collision avoidance system (TCAS) equipment.

Correlated Mathematics Academic Content Benchmarks

- *Explain the effects of operations on the magnitude of quantities.* (Number, Number Sense and Operations F, 8-10)
- *Demonstrate fluency in operations with real numbers, vectors and matrices, using mental computation or paper and pencil calculations for simple cases and technology for more complicated cases.* (Number, Number Sense and Operations D, 11-12)
- *Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.* (Geometry and Spatial Sense C, 8-10)
- *Represent transformations within a coordinate system using vectors and matrices.* (Geometry and Spatial Sense B, 11-12)

Correlated Science Academic Content Benchmarks

- *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 54.3: Explain radio procedures.

Descriptors:

- 54.3.1 Define the very high frequency (VHF) and ultra high frequency (UHF) frequency radio bands.
- 54.3.2 Describe concepts essential to radio use (e.g., phonetic alphabet, time factors, signals, frequencies).

Correlated Mathematics Academic Content Benchmarks

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

Correlated Science Academic Content Benchmarks

- *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)

Unit 55: Meteorology

BIL: Essential

EDU:	12	AD
	I	P

Competency 55.1: Discuss the atmosphere and atmospheric elements.

Descriptors:

- 55.1.1 Describe the atmosphere.
- 55.1.2 Identify the atmospheric elements and atmospheric regions.
- 55.1.3 Define terms associated with the atmosphere (e.g., pressure, condensation, evaporation, precipitation, humidity).
- 55.1.4 Define heat transfer, balance and insulation.
- 55.1.5 Describe the effects of gravity, friction and centrifugal force on wind.
- 55.1.6 Describe turbulence around mountains and the characteristics of jet streams.

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)

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 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)
- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)
- *Describe and interpret rates of change from graphical and numerical data.* (Patterns, Functions and Algebra J, 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

- *Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.* (Earth and Space Sciences B, 11-12)
- *Explain that many processes occur in patterns within the Earth's systems.* (Earth and Space Sciences B, 9-10)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 55.2: Explain basic weather theory.

Descriptors:

- 55.2.1 Describe the composition of the atmosphere.
- 55.2.2 Explain the causes of atmospheric circulation.
- 55.2.3 Discuss wind patterns.

Correlated Mathematics Academic Content Benchmarks

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

Correlated Science Academic Content Benchmarks

- *Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.* (Earth and Space Sciences B, 11-12)
- *Explain that many processes occur in patterns within the Earth's systems.* (Earth and Space Sciences B, 9-10)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 55.3: Interpret weather patterns.

Descriptors:

- 55.3.1 Describe factors related to atmospheric stability (e.g., clouds, fronts, air masses, precipitation).
- 55.3.2 Discuss the effects of temperature inversions.
- 55.3.3 Describe cycles of moisture.

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)
- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 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

- *Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.* (Earth and Space Sciences B, 11-12)
- *Explain that many processes occur in patterns within the Earth's systems.* (Earth and Space Sciences B, 9-10)

BIL: Essential

EDU:	12	AD
	I	P

Competency 55.4: Discuss weather hazards.

Descriptors:

- 55.4.1 Describe the types and impact of thunderstorms.
- 55.4.2 Describe the types, conditions and factors of turbulence.
- 55.4.3 Define wind shear.
- 55.4.4 Describe the effect of icing on aviation.
- 55.4.5 Describe the limitations of visibility on aviation.
- 55.4.6 Describe the characteristics of a tornado.
- 55.4.7 Describe the characteristics of a hurricane.
- 55.4.8 Compare and contrast the effects of tropical and arctic weather hazards.

Correlated Mathematics Academic Content Benchmarks

- *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

- *Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.* (Earth and Space Sciences B, 11-12)

BIL: Essential

EDU:	12	AD
	I	P

Competency 55.5: Interpret weather data.

Descriptors:

- 55.5.1 Identify the various types of weather forecasts.
- 55.5.2 Identify the agencies that provide weather data.
- 55.5.3 Explain the purpose of the Fujita-Pearson scale and the Saffir-Simpson scale.

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)
- *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)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.* (Earth and Space Sciences B, 11-12)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 55.6: Describe the printed weather reports and forecasts.

Descriptors:

- 55.6.1 Identify the various printed weather reports and forecasts.
- 55.6.2 Describe the respective function and purpose of each report and forecast.
- 55.6.3 Identify the elements of the respective weather reports and forecasts.

Correlated Mathematics Academic Content Benchmarks

- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Use a variety of mathematical representations flexibly and appropriately to organize, record and communicate mathematical ideas.* (Mathematical Processes E, 8-10)

Correlated Science Academic Content Benchmarks

- *Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.* (Earth and Space Sciences B, 11-12)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 55.7: Describe graphic weather products

Descriptors:

- 55.7.1 Identify the different types of graphic weather charts and forecasts.
- 55.7.2 Describe the purpose and function of each type.

Correlated Mathematics Academic Content Benchmarks

- *Use a variety of mathematical representations flexibly and appropriately to organize, record and communicate mathematical ideas.* (Mathematical Processes E, 8-10)

Correlated Science Academic Content Benchmarks

- *Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems.* (Earth and Space Sciences B, 11-12)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 55.8: Identify sources of weather information.

Descriptors:

- 55.8.1 Describe the pre-flight weather services.
- 55.8.2 Identify sources of in-flight weather services.
- 55.8.3 Describe the function of the Center Weather Advisory.

Correlated Mathematics Academic Content Benchmarks

- *Use a variety of mathematical representations flexibly and appropriately to organize, record and communicate mathematical ideas. (Mathematical Processes E, 8-10)*

Unit 56: Flight Environment

Note: Throughout Unit 56, students are expected to learn and use vocabulary specific to the aviation technology 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 56.1: Identify and define the rules of flight.

Descriptors:

- 56.1.1 Define and differentiate visual flight rules (VFR) and instrument flight rules (IFR).
56.1.2 Discuss right of way and minimum safe altitude rules.

Correlated Mathematics Academic Content Benchmarks

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

BIL: Essential

EDU:	12	AD
	I	P

Competency 56.2: Explain the grid system used in navigation.

Descriptors:

- 56.2.1 Describe how the coordinates are listed.
56.2.2 Identify and define the terms used in the navigational system.
56.2.3 Explain the positions of latitude, longitude and prime meridian.
56.2.4 Distinguish between sectional and world aeronautical charts.
56.2.5 Explain the purpose and function of sectional charts.
56.2.6 Identify and describe the symbols found on aeronautical charts.
56.2.7 Describe the navigational aids, elevations and topographical information found on aeronautical charts.

Correlated English Language Arts Academic Content Benchmarks

- *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 proportional reasoning and apply indirect measurement techniques, including right triangle trigonometry and properties of similar triangles, to solve problems involving measurements and rates.* (Measurement D, 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)
- *Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.* (Geometry and Spatial Sense C, 8-10)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: Essential

EDU:	12	AD
	I	P

Competency 56.3 Explain the pilotage and dead-reckoning methods of navigation.

Descriptors:

- 56.3.1 Differentiate the pilotage from the dead-reckoning methods.
- 56.3.2 Describe some of the landmarks used in pilotage.
- 56.3.3 Identify terms associated with dead reckoning.
- 56.3.4 Define the VFR cruising altitude rules and flight plan form.

Correlated Mathematics Academic Content Benchmarks

- *Connect physical, verbal and symbolic representations of integers, rational numbers and irrational numbers.* (Number, Number Sense and Operations D, 8-10)
- *Develop an understanding of properties of and representations for addition and multiplication of vectors and matrices.* (Number, Number Sense and Operations B, 11-12)

BIL: Essential

EDU:	12	AD
	I	P

Competency 56.4: Explain the VHF omni-directional range (VOR) navigation system.

Descriptors:

- 56.4.1 Identify and define the different types of VORs.
- 56.4.2 Explain how the VOR operates.

Correlated Mathematics Academic Content Benchmarks

- *Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.* (Geometry and Spatial Sense C, 8-10)
- *Represent and model transformations in a coordinate plane and describe the results.* (Geometry and Spatial Sense F, 8-10)
- *Use right triangle trigonometric relationships to determine lengths and angle measures.* (Geometry and Spatial Sense I, 8-10)
- *Use trigonometric relationships to verify and determine solutions in problem situations.* (Geometry and Spatial Sense A, 11-12)
- *Represent transformations within a coordinate system using vectors and matrices.* (Geometry and Spatial Sense B, 11-12)

Correlated Science Academic Content Benchmarks

- *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 56.5: **Explain the automatic direction finding (ADF) navigation systems.**

Descriptors:

- 56.5.1 Define the non-directional beacon (NBD) system of navigation.
- 56.5.2 Identify the terms used in ADF navigation.
- 56.5.3 Explain the radio magnetic indicator.

Correlated Science Academic Content Benchmarks

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

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 56.6: **Discuss advanced navigation systems.**

Descriptors:

- 56.6.1 Describe the range navigation (RNAV) and inertial navigation (INS) systems.
- 56.6.2 Describe the long range navigation (LORAN) and global positioning unit (GPS) systems.

Correlated Science Academic Content Benchmarks

- *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 56.7: Explain the classification and control of airspace.

Descriptors:

- 56.7.1 Identify and describe the classes of airspace.
- 56.7.2 Distinguish federal and special use from other airways.
- 56.7.3 Identify the respective airspeed limitations for airspace.

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

Unit 57: Aerodynamics

Note: Throughout Unit 57, students are expected to learn and use vocabulary specific to the aviation technology 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 57.1 Describe the basics in aeronautics and aerodynamics.

Descriptors:

- 57.1.1 Define aeronautics and aerodynamics.
57.1.2 Describe the differences between aeronautics and aerodynamics.

BIL: Essential

EDU:	12	AD
	I	P

Competency 57.2: Describe aerodynamic principles.

Descriptors:

- 57.2.1 Describe the forces of flight.
57.2.2 Identify the three axis of motion.
57.2.3 Define Newton's laws of motion.
57.2.4 Describe Bernoulli's principle.
57.2.5 Identify and define the parts of an airfoil..
57.2.6 Describe how an airfoil works.
57.2.7 Identify wing design factors.
57.2.8 Discuss the role of thrust.
57.2.9 Describe the relationship between lift and drag.

Correlated Mathematics Academic Content Benchmarks

- *Develop an understanding of properties of and representations for addition and multiplication of vectors and matrices.* (Number, Number Sense and Operations B, 11-12)
- *Demonstrate fluency in operations with real numbers, vectors and matrices, using mental computation or paper and pencil calculations for simple cases and technology for more complicated cases.* (Number, Number Sense and Operations D, 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)

- *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)
- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)

Correlated Science Academic Content Benchmarks

- *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 57.3: Explain the aerodynamic principle of stability.

Descriptors:

- 57.3.1 Define and explain lateral and directional stability.
- 57.3.2 Describe the axes of flight.
- 57.3.3 Explain the center of gravity (CG) concepts.
- 57.3.4 Discuss the effects of power on stability.
- 57.3.5 Explain the purpose of the horizontal stabilizer.
- 57.3.6 Describe the types and phases of spins and spin recovery.

Correlated Mathematics Academic Content Benchmarks

- *Develop an understanding of properties of and representations for addition and multiplication of vectors and matrices.* (Number, Number Sense and Operations B, 11-12)
- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)
- *Solve systems of linear equations involving two variables graphically and symbolically.* (Patterns, Functions and Algebra H, 8-10)

Correlated Science Academic Content Benchmarks

- *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 57.4: Explain the aerodynamics of maneuvering flight.

Descriptors:

- 57.4.1 Identify the effects of torque.
- 57.4.2 Define gyroscopic precession.
- 57.4.3 Define asymmetrical thrust.
- 57.4.4 Explain spiraling slipstream.
- 57.4.5 Discuss the factors affecting glide.
- 57.4.6 Define load factor.
- 57.4.7 Explain G-forces.

Correlated Mathematics Academic Content Benchmarks

- *Develop an understanding of properties of and representations for addition and multiplication of vectors and matrices.* (Number, Number Sense and Operations B, 11-12)
- *Solve systems of linear equations involving two variables graphically and symbolically.* (Patterns, Functions and Algebra H, 8-10)

Correlated Science Academic Content Benchmarks

- *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 57.5: Explain aircraft performance factors.

Descriptors:

- 57.5.1 Identify the factors affecting aircraft performance.
- 57.5.2 Identify the factors of takeoff and landing performance.
- 57.5.3 Describe the factors of climb and cruise performance.
- 57.5.4 Describe the principles of weight and balance and the affect of center of gravity.
- 57.5.5 Identify the features of the mechanical flight computer, and explain their respective functions.

Correlated Mathematics Academic Content Benchmarks

- *Develop an understanding of properties of and representations for addition and multiplication of vectors and matrices.* (Number, Number Sense and Operations B, 11-12)
- *Solve systems of linear equations involving two variables graphically and symbolically.* (Patterns, Functions and Algebra H, 8-10)

Correlated Science Academic Content Benchmarks

- *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: **Recommended**

EDU:	12	AD
	I	P

Competency 57.6: **Discuss advances in aeronautics.**

Descriptors:

- 57.6.1 Discuss the importance of composite materials.
- 57.6.2 Discuss the research of solar aircraft.
- 57.6.3 Discuss the advancements in military and civil aviation.
- 57.6.4 Discuss the latest in technological breakthroughs (e.g., scramjet).

Correlated English Language Arts Academic Content Benchmarks

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

Correlated Science Academic Content Benchmarks

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

Unit 58: Aviation Human Factors

BIL: Essential

EDU:	12	AD
	I	P

Competency 58.1: Explore aviation physiology.

Descriptors:

- 58.1.1 Define aviation physiology.
- 58.1.2 Identify the flight problems associated with aviation physiology.
- 58.1.3 Describe the effects of hypoxia and carbon monoxide.
- 58.1.4 Identify the rules of supplemental oxygen.

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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 58.2: Analyze aeronautical decision-making.

Descriptors:

- 58.2.1 Describe the decision-making process in flight.
- 58.2.2 Explain the poor judgment chain.
- 58.2.3 Describe the effects of good communications.
- 58.2.4 Identify the personal self-assessment checklist.
- 58.2.5 Explain the benefits of internal and external resources.
- 58.2.6 Identify hazardous attitudes of flight.

Correlated Mathematics Academic Content Benchmarks

- *Solve problem situations involving derived measurements; e.g., density, acceleration.* (Measurement D, 11-12)
- *Use trigonometric relationships to verify and determine solutions in problem situations.* (Geometry and Spatial Sense A, 11-12)
- *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)
- *Describe and interpret rates of change from graphical and numerical data.* (Patterns, Functions and Algebra J, 8-10)
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Assess the adequacy and reliability of information available to solve a problem.* (Mathematical Processes C, 11-12)

Unit 59: Safety

BIL: Essential

EDU:	12	AD
	I	P

Competency 59.1: Analyze the importance of safety compliance management in accident prevention.

Descriptor:

- 59.1.1 Describe the role of the airline safety department.
- 59.1.2 Describe approaches to accident prevention.
- 59.1.3 Explain the role of maintenance and flight operation in accident prevention.
- 59.1.4 Describe methods to feedback safety information.

BIL: Essential

EDU:	12	AD
	I	P

Competency 59.2: Distinguish between security and safety.

Descriptors:

- 59.2.1 Explain how terrorists have changed tactics in airline security.
- 59.2.2 Discuss the role of the Department of Homeland Security (DHS), the Transportation Security Administration (TSA), the Federal Aviation Administration (FAA) and the Federal Bureau of Investigation (FBI) concerning aviation security.
- 59.2.3 Discuss the role of the Department of Transportation (DOT) and the FAA concerning aviation safety.
- 59.2.4 Explain the difficulties with identifying and measuring terrorist threats.
- 59.2.5 Describe technological advances in security.

BIL: Essential

EDU:	12	AD
	I	P

Competency 59.3: Associate the impact of safety data analysis on aviation safety.

Descriptors:

- 59.3.1 Explain strategies used to gather safety data.
- 59.3.2 Describe the purpose of the Air Operator Data System.
- 59.3.3 Identify the responsibilities of the Aviation Standards National Field Office.
- 59.3.4 Differentiate fatal aviation accident factors from secondary accident factors.
- 59.3.5 Categorize accident, safety and security incidents.
- 59.3.6 Discuss the role of risk management in aviation safety.

Correlated Mathematics Academic Content Benchmarks

- *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
	I	P

Competency 59.4: **Explain the nature of the human factor on accidents.**

Descriptors:

- 59.4.1 Describe the extent of human factors in aircraft accidents.
- 59.4.2 Identify physiological (e.g., age, health) and psychological factors.
- 59.4.3 Explain the impact of pilot training, experience and regulation enforcement.
- 59.4.4 Describe the impact of federal, airline and labor on the human factors.

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)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 59.5: **Explain strategies to manage human error.**

Descriptors:

- 59.5.1 Describe corrective actions used by airline management.
- 59.5.2 Discuss the impact of cockpit standardization on accident prevention.
- 59.5.3 Discuss the impact of cockpit automation on human error.

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)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 59.6: Describe the impact of air traffic systems on safety.

Descriptors:

- 59.6.1 Describe the roles of control towers, terminal radar approach controls and air route traffic control centers.
- 59.6.2 Describe the advantages of satellite-based navigation.
- 59.6.3 Describe the surface movement advisor system.

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

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 59.7: Explain the role of the National Transportation Safety Board (NTSB) in accident investigations.

Descriptors:

- 59.7.1 Describe the purpose of the NTSB.
- 59.7.2 List the types of accidents investigated by the NTSB.
- 59.7.3 Describe the major steps in investigating a commercial aviation accident.

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 59.8: Describe flight standards and rulemaking policies.

Descriptors:

- 59.8.1 Describe the FAA’s responsibilities to aviation safety.
- 59.8.2 Identify the FAA’s rulemaking process.
- 59.8.3 Discuss the mission and function of the Flight Standards Service.
- 59.8.4 Summarize the types of inspections conducted by the Flight Standards District Office (FSDO).
- 59.8.5 Describe the Air Transportation Oversight System.

Unit 60: Rocket Fundamentals

BIL: Recommended

EDU:	12	AD
	I	P

Competency 60.1: Evaluate the role rockets play in the aviation industry.

Descriptors:

- 60.1.1 Trace the historical evolution of rocket science.
- 60.1.2 Identify the major scientific contributors to rocket science, and describe their respective contributions.
- 60.1.3 Identify and define terms common to rocket fundamentals (e.g., gravity, force, velocity, acceleration, thrust).
- 60.1.4 Identify and describe the systems and parts of a rocket engine.

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

Correlated Mathematics Academic Content Benchmarks

- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 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 movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

BIL: Recommended

EDU:	12	AD
	I	P

Competency 60.2: Explain the fundamental concept of chemical propulsion.

Descriptors:

- 60.2.1 Describe the chemical reaction causing the propelling force.
- 60.2.2 Identify the chemical propellants used in rocket propulsion.
- 60.2.3 Describe the solid propellant chemical system.
- 60.2.4 Describe the liquid propellant chemical system.
- 60.2.5 Describe the function of each component in a chemical propellant system.

Correlated Mathematics Academic Content Benchmarks

- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 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 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)
- *Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.* (Physical Sciences B, 9-10)

BIL: **Recommended**

EDU:	12	AD
	I	P

Competency 60.3: Explore orbits and trajectories

Descriptors:

- 60.3.1 Distinguish orbit from trajectory.
- 60.3.2 Describe the fundamental science of orbits.
- 60.3.3 Describe the concept of velocity as it relates to maintaining or exiting an orbit (e.g., escape, burnout, relation to height).
- 60.3.4 Describe the transfer methods for launching a vehicle.
- 60.3.5 Explain the function of satellites placed in space.

Correlated Mathematics Academic Content Benchmarks

- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 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 movement of objects by applying Newton's three laws of motion.* (Physical Sciences D, 9-10)

Unit 61: Space Environment

BIL: Recommended

EDU:	12	AD
	I	P

Competency 61.1: Explore the space environment.

Descriptors:

- 61.1.1 Discuss the rationale for space exploration.
- 61.1.2 Identify and describe the components of space (e.g., lower limits, interplanetary, interstellar, cosmic rays).
- 61.1.3 Describe the divisions of the sun's atmosphere.
- 61.1.4 Describe solar phenomena (e.g., wind, emissions).
- 61.1.5 Describe the earth's ionosphere.
- 61.1.6 Describe the characteristics of the magnetosphere.
- 61.1.7 Describe the Van Allen radiation belts.
- 61.1.8 Describe the effects of the earth's atmosphere and vacuum on spacecraft.

Correlated Science Academic Content Benchmarks

- *Explain how technology can be used to gather evidence and increase our understanding of the universe.* (Earth and Space Sciences A, 11-12)
- *Explain the 4.5 billion-year-history of Earth and the 4 billion-year-history of life on Earth based on observable scientific evidence in the geologic record.* (Earth and Space Sciences C, 9-10)

BIL: Recommended

EDU:	12	AD
	I	P

Competency 61.2: Examine our solar system.

Descriptors:

- 61.2.1 Define the parameters of our solar system.
- 61.2.2 Identify the planets and describe their characteristics.
- 61.2.3 Describe various discoveries from moon exploration.
- 61.2.4 Identify various probes into the solar system, and describe the results.
- 61.2.5 Describe various space phenomena (e.g., asteroid, comet, nova, black hole, nebula, light year).

Correlated Science Academic Content Benchmarks

- *Explain the 4.5 billion-year-history of Earth and the 4 billion-year-history of life on Earth based on observable scientific evidence in the geologic record.* (Earth and Space Sciences C, 9-10)
- *Explain how technology can be used to gather evidence and increase our understanding of the universe.* (Earth and Space Sciences A, 11-12)

BIL: Recommended

EDU:	12	AD
	I	P

Competency 61.3: Summarize unmanned space exploration.

Descriptors:

- 61.3.1 Discuss early unmanned space exploration efforts.
- 61.3.2 Explain space law, treaties and legislative acts.
- 61.3.3 Explain the functions of the various satellites.
- 61.3.4 Discuss conventional uses generated from space discoveries (e.g., global positioning systems).

Correlated Mathematics Academic Content Benchmarks

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

- *Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.* (Earth and Space Sciences F, 9-10; D, 11-12)

BIL: Recommended

EDU:	12	AD
	I	P

Competency 61.4: Summarize manned space exploration.

Descriptors:

- 61.4.1 Identify the contributions of national and international space flights.
- 61.4.2 Identify the major parts of the space shuttle system.
- 61.4.3 Explain the role the space lab plays in space exploration.
- 61.4.4 Discuss the issues and trends currently impacting space exploration.

Correlated Mathematics Academic Content Benchmarks

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

- *Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.* (Earth and Space Sciences F, 9-10; Earth and Space Sciences D, 11-12)

Unit 62: Management

BIL: Recommended

EDU:	12	AD
	I	P

Competency 62.1: Summarize the structure and function of aviation-based businesses and services.

Descriptors:

- 62.1.1 Use organizational charts to identify a workplace structure.
- 62.1.2 Explore the functions of the departments and units within an organization.
- 62.1.3 Identify business reporting and information flow.
- 62.1.4 Describe current and future business trends and their impact on aviation-based businesses and services.

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

- *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)
- *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)
- *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 62.2: Describe management concepts.

Descriptors:

- 62.2.1 Identify the major functions of management.
- 62.2.2 Define management styles.
- 62.2.3 Explain the role of authority, accountability and responsibility in task accomplishment.
- 62.2.4 Explore continuous improvement programs.

BIL: Recommended

EDU:	12	AD
	I	P

Competency 62.3: Manage human resources.

Descriptors:

- 62.3.1 Analyze the impact of human resources on organizational success.
- 62.3.2 Explain human resources functions and strategies (e.g., recruiting, training, managing, evaluating, motivating).
- 62.3.3 Manage an employee performance development and improvement plan.
- 62.3.4 Summarize wage and hour, discrimination, harassment and access based on federal, state and local laws.
- 62.3.5 Recognize signs of addiction, substance abuse and mental illness, and comply with appropriate laws and company policies.
- 62.3.6 Identify factors contributing to stress.

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)
- *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)
- *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	P

Competency 62.4: Perform personnel staffing functions..

Descriptors:

- 62.4.1 Prepare job descriptions.
- 62.4.2 Identify techniques to recruit, hire, train, appraise, discipline and terminate employees.
- 62.4.3 Identify and describe most critical performance problems.

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)

BIL: Recommended

EDU:	12	AD
	I	P

Competency 62.5: Conduct orientation and training sessions.

Descriptors:

- 62.5.1 Establish training for job specific activities.
- 62.5.2 Establish processes for retaining good staff.

Correlated English Language Arts Academic Content Benchmarks

- *Give informational presentations that contain a clear perspective, present ideas from multiple sources in logical sequence and include a consistent organizational structure. (Communications: Oral and Visual E, 11-12)*

BIL: Essential

EDU:	12	AD
	I	P

Competency 62.6: Discuss leadership principles in aviation-based businesses and services.

Descriptors:

- 62.6.1 Compare and contrast different leadership styles.
- 62.6.2 Identify methods to build employee morale.
- 62.6.3 Describe methods to create motivating environments for employees to succeed.
- 62.6.4 Discuss the relationship between communication and employee attitude.
- 62.6.5 Discuss the impact of employee participation in decision-making.
- 62.6.6 Provide feedback regarding work efforts.
- 62.6.7 Propose strategies to address employee complaints and grievances.
- 62.6.8 Discuss the impact of employee attitude and morale on customer service.

Correlated English Language Arts Academic Content Benchmarks

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

BIL: **Recommended**

EDU:	12	AD
	I	P

Competency 62.7: **Explain how planning and budgeting are used to accomplish organizational goals and objectives.**

Descriptors:

- 62.7.1 Explain how work plans and budgets are used to allocate people and resources.
- 62.7.2 Examine reports on performance and resource utilization.
- 62.7.3 Explain how plans and budgets are revised to meet goals and objectives.
- 62.7.4 Identify reports used to track performance and resources, and explain how they are used.
- 62.7.5 Describe value analysis through cost versus benefits.
- 62.7.6 Explain cost and profit relationships to guide business decision-making.

Correlated Mathematics Academic Content Benchmarks

- *Solve systems of linear equations involving two variables graphically and symbolically.* (Patterns, Functions and Algebra H, 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)
- *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**

EDU:	12	AD
	I	P

Competency 62.8: **Explore budgeting skills to determine staffing levels.**

Descriptors:

- 62.8.1 Calculate labor hours for each level of customer traffic.
- 62.8.2 Calculate the number of employees to schedule at each level.
- 62.8.3 Set staffing schedules to balance labor costs and the level of customer traffic.

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)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)
- *Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences.* (Mathematical Processes F, 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	P

Competency 62.9: Explain the nature and scope of finance and controlling functions.

Descriptors:

- 62.9.1 Explain employee's role in expense control.
 62.9.2 Explain the critical nature of banking relationships.
 62.9.3 Explain the purposes and importance of obtaining business financing.
 62.9.4 Describe sources of financing for businesses.

BIL: Recommended

EDU:	12	AD
	I	P

Competency 62.10: Explain basic accounting concepts and principles.

Descriptors:

- 62.10.1 Describe basic accounting principles and applications.
 62.10.2 Explain accounting terminology.
 62.10.3 Describe recordkeeping procedures.
 62.10.4 Explain periodic reporting procedures.
 62.10.5 Interpret balance sheets, income statements, cash-flow statements, and other accounting documentation.
 62.10.6 Prepare budgets, break-even analysis, cost and revenue analyses, and forecasts.

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)

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

BIL: Recommended

EDU:	12	AD
	I	I

Competency 62.11: Establish criteria for purchasing products and services.

Descriptors:

- 62.11.1 Explain the nature and scope of purchasing.
- 62.11.2 Describe buying and purchasing policies.
- 62.11.3 Establish criteria for managing the buying process.
- 62.11.4 Establish criteria for qualifying vendors.
- 62.11.5 Explain bidding process and select vendors.
- 62.11.6 Describe negotiation of contracts with vendors.
- 62.11.7 Review the performance of vendors.

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

BIL: Recommended

EDU:	12	AD
	I	I

Competency 62.12: Explain the material control and product inventories necessary to meet customer and business requirements.

Descriptors:

- 62.12.1 Explain the relationship of quality control to supply of materials.
- 62.12.2 Describe and perform inventory control systems.
- 62.12.3 Explain the impact of inventory control systems on productivity and on profit and loss.

Correlated Mathematics Academic Content Benchmarks

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

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 62.13: **Manage customer relationships.**

Descriptors:

- 62.13.1 Assess customer satisfaction.
- 62.13.2 Review customer behavior (e.g., habits, purchasing patterns, needs).
- 62.13.3 Describe ways to eliminate gaps in customer satisfaction and expectations.
- 62.13.4 Set customer service standards in terms of timeliness, accuracy and appropriateness.
- 62.13.5 Examine company performance relative to customer priorities.

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

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

BIL: Recommended

EDU:	12	AD
	I	P

Competency 62.14: Examine risk management.

Descriptors:

- 62.14.1 Describe types of risks, and explain risk management.
- 62.14.2 Identify speculative business risks.
- 62.14.3 Describe routine security precautions.
- 62.14.4 Describe strategies to protect digital data.
- 62.14.5 Examine liability issues.
- 62.14.6 Examine marketing risks.
- 62.14.7 Explain processes to limit or transfer risk.
- 62.14.8 Describe disaster preparedness and recovery plans.

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 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)
- *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 62.15: Describe business risks.

Descriptors:

- 62.15.1 Identify types of insurance coverage.
- 62.15.2 Follow policies and procedures for preventing theft (e.g., internal, vendor, burglary).
- 62.15.3 Describe a product or service contract.
- 62.15.4 Describe procedures for safeguarding cash.
- 62.15.5 Inspect financial transactions for fraud (e.g., counterfeit bills, check authenticity).

Correlated English Language Arts Academic Content Benchmarks

- *Analyze the features and structures of documents and critique them for their effectiveness.* (Reading: Informational, Technical and Persuasive Text A, 11-12)

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 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)
- *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)
- *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 62.16: Complete a business plan.

Descriptors:

- 62.16.1 Conduct a feasibility analysis for new business.
- 62.16.2 Develop company goals and objectives.
- 62.16.3 Describe different organizational structures and their roles in strategic planning.
- 62.16.4 Forecast income and sales.
- 62.16.5 Describe, review and make changes in the mission statement when appropriate.

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)
- *Apply editing strategies to eliminate slang and improve conventions.* (Writing Process D, 11-12)
- *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)
- *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)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)

Unit 63: Marketing Functions

BIL: Essential

EDU:	12	AD
	I	P

Competency 63.1: Examine marketing and its role in an aviation-based businesses and services.
Descriptors:

- 63.1.1 Explain the marketing concept and its role in an aviation-based businesses and services.
- 63.1.2 Identify the primary functions of marketing.
- 63.1.3 Describe types of marketing information used by managers.
- 63.1.4 Identify types of communication channels (e.g., formal, informal).
- 63.1.5 Define stakeholder relationships (e.g., customers, employees, shareholders, suppliers).
- 63.1.6 Describe the scope of marketing (e.g., business-to-customer, business-to-business).
- 63.1.7 Define marketing mix.
- 63.1.8 Define customer profile.
- 63.1.9 Describe current marketing trends.

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

EDU:	12	AD
	I	P

Competency 63.2: Complete a marketing plan.
Descriptors:

- 63.2.1 Establish a marketing plan.
- 63.2.2 Conduct marketing audits.
- 63.2.3 Monitor marketing conditions.
- 63.2.4 Examine the performance of the marketing plan.

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

- *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)
- *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)
- *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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 63.3: Describe the promotion function.

Descriptors:

- 63.3.1 Distinguish promotions from publicity.
- 63.3.2 Explain the nature and scope of the promotional mix.
- 63.3.3 Explain examples of promotion.
- 63.3.4 Describe the promotional planning process.
- 63.3.5 Identify the various approaches to advertising.

Correlated English Language Arts Academic Content Benchmarks

- *Identify and analyze examples of rhetorical devices and valid and invalid inferences.* (Reading: Informational, Technical and Persuasive Text B, 11-12)

BIL: **Essential**

EDU:	12	AD
	I	P

Competency 63.4: Identify targeted markets.

Descriptors:

- 63.4.1 Prospect for customers by reviewing historical data.
- 63.4.2 Prospect for customers using meeting, convention and association data.
- 63.4.3 Acquire leads and referrals from satisfied customers.
- 63.4.4 Follow procedures for qualifying customers.

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)

BIL: **Recommended**

EDU:	12	AD
	I	P

Competency 63.5: Explain the sales cycle.

Descriptors:

- 63.5.1 Respond to requests for proposals.
- 63.5.2 Work with industry partners to develop proposals.
- 63.5.3 Complete a sales proposal, including legal terms and conditions.
- 63.5.4 Complete sales contracts.
- 63.5.5 Explain follow-up strategies.
- 63.5.6 Maintain a customer database.

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to revise content, organization and style, and to improve word choice, sentence variety, clarity and consistency of writing.* (Writing Process C, 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

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

- *Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences. (Mathematical Processes F, 11-12)*
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Mathematical Processes I, 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)*

BIL: Essential

EDU:	12	AD
	I	P

Competency 63.6: Explain the role of customer service as a component of marketing relationships.

Descriptors:

- 63.6.1 Distinguish between customer service as a process and customer service as a function.
- 63.6.2 Explain how customer service facilitates sales relationships.
- 63.6.3 Identify occasions when customer service can be used to facilitate sales relationships.
- 63.6.4 Identify obvious or apparent benefits.

BIL: Essential

EDU:	12	AD
	I	P

Competency 63.7: Describe selling processes and techniques.

Descriptors:

- 63.7.1 Acquire product and/or service knowledge.
- 63.7.2 Create presentation materials.
- 63.7.3 Identify the audience and/or clients and their needs and motives.
- 63.7.4 Differentiate between consumer and organizational buying behavior.
- 63.7.5 Demonstrate strategies for presenting features and benefits.
- 63.7.6 Demonstrate negotiation skills.
- 63.7.7 Sell goods, services and/or ideas to individuals and groups.

Correlated English Language Arts Academic Content Benchmarks

- *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)*
- *Use a variety of strategies to enhance listening comprehension. (Communications: Oral and Visual A, 8-10; Communications: Oral and Visual A, 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 persuasive presentations that structure ideas and arguments in a logical fashion, clarify and defend positions with relevant evidence and anticipate and address the audience's concerns. (Communications: Oral and Visual D, 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)
- *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)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 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)

BIL: **Recommended**

EDU:	12	AD
	I	P

Competency 63.8: **Describe sales support activities.**

Descriptors:

- 63.8.1 Calculate miscellaneous charges.
- 63.8.2 Use technology to sell products.
- 63.8.3 Use presentation software to develop sales presentations and materials.
- 63.8.4 Identify sales support services and the benefits to customers.

Correlated English Language Arts Academic Content Benchmarks

- *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)
- *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

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement 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)
- *Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences.* (Mathematical Processes F, 11-12)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 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)

BIL: Recommended

EDU:	12	AD
	I	P

Competency 63.9: Manage selling activities.

Descriptors:

- 63.9.1 Explain the nature of sales management.
- 63.9.2 Plan strategies for meeting sales goals.
- 63.9.3 Review sales reports.
- 63.9.4 Forecast sales.
- 63.9.5 Create appropriate customer response standards (e.g., e-mail, facsimiles, voice mail).

Correlated English Language Arts Academic Content Benchmarks

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

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)
- *Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences.* (Mathematical Processes F, 11-12)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 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)

BIL: Essential

EDU:	12	AD
	I	P

Competency 63.10: Evaluate pricing fundamentals.

Descriptors:

- 63.10.1 Explain pricing functions and objectives.
- 63.10.2 Evaluate the role of business ethics in pricing.
- 63.10.3 Discuss the price-setting process (e.g., price sensitivity, competitor's prices).
- 63.10.4 Evaluate the relationship between price and value.

Correlated Mathematics Academic Content Benchmarks

- *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)
- *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 63.11: Evaluate pricing strategies.

Descriptors:

- 63.11.1 Evaluate features, purposes, advantages and disadvantages of cost-based, demand-based and competition-based pricing strategies.
- 63.11.2 Evaluate pricing techniques (e.g., psychological, discount, promotional).
- 63.11.3 Describe the relationship between pricing and revenue or yield management strategies.

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)

Appendix A

Industry-Driven Authentic Assessment Based on SkillsUSA

Appendix

Industry-Driven Authentic Assessment Based on SkillsUSA

Industry-driven, authentic assessments based on the career-technical student organization, SkillsUSA, are linked to various competencies. This demonstrates the co-curricular nature of the career-technical student organization and provides an opportunity for authentic assessment of a student's knowledge and skills at the local, regional, state and national levels. Complete information on the assessments, including scoring rubrics, can be obtained at www.ohioskillsusa.org.

Unit 2: Business Processes

Customer Service – Evaluates an individual's ability to apply concepts of communication, professionalism, ethics and the business process to the field of customer service.

Unit 3: Communications

Prepared Speech – Evaluates an individual's ability to apply concepts of English/Language Arts to prepare and present, clearly and effectively a series of thoughts relating to a central theme.

Extemporaneous Speaking – Evaluates an individual's ability to apply concepts of English/Language Arts and communication to give a speech on an assigned topic with a minimum of advance notice.

Job Interview – Evaluates an individual's ability to apply concepts of English/Language Arts in written, verbal and non-verbal form in employment procedures as applied to an employment opportunity.

Unit 5: Leadership and Teamwork

American Spirit – Evaluates a local chapter's ability to work as a team in activities such as community service or citizenship projects.

Chapter Business Procedure – Evaluates a local chapter's ability to work as a team to conduct a meeting using correct parliamentary procedure.

Chapter Display – Evaluates a local chapter's ability to work as a team to construct a promotional display.

Community Service – Evaluates a local chapter's ability to give leadership to a community service project and to work as a team to realize positive outcomes.

TeamWorks – Evaluates a team's ability to apply concepts of mathematics, science, and technology in collaborating on a project.

Unit 8: Safety, Health and Environmental

Occupational Health and Safety – Evaluates a team’s promotion of good health and safety habits in the workplace.

First Aid/CPR – Evaluates a student’s ability to react positively in a simulated situation demanding first aid intervention and to recognize excellence and professionalism in administering first aid and Cardiopulmonary Resuscitation (CPR).

Unit 10: Transportation Systems Technical Skills Set

Job Skills Demonstration – Evaluates an individual’s ability to apply and verbalize concepts of mathematics, science, and technology to demonstrate and explain an entry level skill used in the occupation area for which he or she is training.

Unit 12, 23, 30, 42: Tools and Equipment Units

Job Skills Demonstration – Evaluates an individual’s ability to apply and verbalize concepts of mathematics, science, and technology to demonstrate and explain an entry level skill used in the occupation area for which he or she is training

Units 11-21: Automotive Technician

Automotive Technology – Evaluates an individual’s ability to apply mathematics, science, and technology to inspect, diagnosis, and repair a variety of vehicles commonly sold in the United States. Skills include, but are not limited to engine repair, diagnosis, electrical, brakes, transmission, steering and suspension, customer service, and parts identification.

Units 22-29: Collision Repair Technician

Collision Repair Technician - Evaluate an individual’s ability to apply concept of science and technology to the metalworking, painting, and plastics repair phase of auto collision repair technology including but not limited to painting and refinishing, mechanical, non-structural, structural, electrical, and estimating.

Units 29-40: Medium/Heavy Truck Technician

Diesel Equipment Technology - Evaluates an individual’s ability to apply concepts of science and technology to the inspection, diagnosis, and repair of large diesel engines, transmissions, drive trains, electrical systems, brakes, hydraulic systems and cab components used in farm equipment, truck and construction equipment.

Units 41-49: Power Equipment Technology

Diesel Equipment Technology - Evaluates an individual's ability to apply concepts of science and technology to the inspection, diagnosis, and repair of large diesel engines, transmissions, drive trains, electrical systems, brakes, hydraulic systems and cab components used in farm equipment, truck and construction equipment.

Power Equipment Technology – Evaluates an individual's ability to apply concepts of science and technology to the diagnosis, overhaul and repair of both liquid and air-cooled engines including, but not limited to ignition systems, fuel systems, governor, starter systems, cooling systems, lubrication systems, valves and ports, exhaust systems and engine block components.

Units 44-49: Aviation Maintenance Technician

Aviation Maintenance Technology - Evaluates an individual's ability to apply science and technology to demonstrate proficiency in those competencies classified as general aviation or as powerplant and airframe by the FAA. It includes the inspection, diagnosis, and repair of various aircraft parts including, but not limited to wings, fuselage, trail assembly, cables, propeller assembly, and fuel and oil tanks.

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