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# Diesel Equipment Technology Mississippi Curriculum Framework

Program CIP:

47.0605 – Diesel Mechanics Technology/Technician (Transportation option)

47.0302 – Heavy Equipment Maintenance Technology/Technician (Heavy Equip. option)

February 2015

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The Office of Curriculum and Instruction (OCI) was founded in 2013 under the Division of Workforce, Career, and Technical Education at the Mississippi Community College Board (MCCB). The office is funded through a partnership with The Mississippi Department of Education (MDE), who serves as Mississippi's fiscal agent for state and federal Career and Technical Education (CTE) Funds. The OCI is tasked with developing statewide CTE curriculum, programming, and professional development designed to meet the local and statewide economic demand.

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## RESEARCH ABSTRACT

The curriculum framework in this document reflects these changes in the workplace and a number of other factors that impact local vocational–technical programs. Federal and state legislation calls for articulation between high school and community college programs, integration of academic and vocational skills, and the development of sequential courses of study that provide students with the optimum educational path for achieving successful employment. National skills standards, developed by industry groups and sponsored by the U.S. Department of Education and Labor, provide vocational educators with the expectations of employers across the United States. All of these factors are reflected in the framework found in this document.

This curriculum was revised in 2007, but the last validated and approved revision of this curriculum took place in 2011. In the fall of 2014 and spring of 2015, the Office of Curriculum and Instruction (OCI) met with several different business and industries in Central MS, Northern MS and Southern MS. An industry questionnaire was used to gather feedback concerning the trends and needs, both current and future, of their field. Industry members stated the curriculum was strong, but wanted to encourage students who complete the program to continue becoming certified in additional construction areas. Currently, there are some areas where students are being hired as part-time employees waiting on something full-time to open in the diesel equipment technology field. The Office of Curriculum and Instruction also met with advisory committee members who reiterated what industry had stated. There is a 6.71% increase in occupational demand at the regional level and a 5.63% increase at the state level. Program faculty, administrators, and industry members were consulted regarding industry workforce needs and trends.

## RECENT REVISION HISTORY:

2007-Research & Curriculum Unit, Mississippi State University

2011-Research & Curriculum Unit, Mississippi State University

2015-Office of Curriculum & Instruction, Mississippi Community College Board

## ADOPTION OF NATIONAL CERTIFICATION STANDARDS

The Board of Trustees of the **National Automotive Technicians Education Foundation (NATEF)** is responsible for accreditation of automotive (automobile, collision repair & refinish, medium/heavy truck) programs at secondary and post-secondary levels. NATEF will grant accreditation to programs that comply with the evaluation procedure, meet established standards, and adhere to the policies in this document. Program accreditation is under the direct supervision of the NATEF Board of Trustees and such personnel designated or employed by NATEF.

On January 1, 2011, NATEF assumed the role of accreditation of automotive programs as an extension of its role as the evaluation organization with the family of organizations of the National Institute for Automotive Service Excellence (ASE). The ASE standards for automobile program certification were introduced in 1982. Standards for collision repair & refinish programs were launched in 1989 and truck standards followed in 1992. NATEF's role in the process was to work with industry and education to update the standards on a regular basis and evaluate programs against those standards. Based on a positive evaluation, programs were "certified" by ASE for a period of five (5) years.

After a lengthy process that included discussions with industry, employers, and educators, NATEF conducted a series of workshops and webinars to review the automobile standards. The ASE Student Certification offers certification in Medium/Heavy Trucks.

For more information related to implementing NATEF at your local campus, please visit <http://www.natef.org>.

The **Automobile Service Excellence (ASE) Student Certification** test series for the **2014 NATEF Medium/Heavy Truck Program Standards** is comprised of six examinations covering light vehicle diagnosis and repair. The task lists are simply lists of the tasks involved in the process of diagnosing and repairing problems in the various vehicle systems. The tasks may also be thought of as competencies. Each question found in the tests is keyed to one of these tasks. The tasks are organized into content categories, and these content categories, along with the number of questions included in each category, comprise the test specifications. Every form of the exams will be built to meet these specifications.

For more information related to implementing ASE Student Certification at your local campus, please visit <http://www.asestudentcertification.com>.

## ADOPTION OF NATIONAL CERTIFICATION STANDARDS

The **AED Foundation**, through its committed industry volunteers, is improving the quality of the equipment industry's workforce by publishing and maintaining the "**Standards for Construction Equipment Technology.**" The goal is to help post-secondary institutions prepare students with the knowledge and skills they need to embark on successful careers as equipment service technicians. The contents are regularly reviewed and updated by The AED Foundation's Technical Training Committee in response to changes in technology and learning requirements.

Now in its **eighth edition**, this document is the result of voluntary efforts by technical experts in the construction equipment industry. The project is sponsored by The AED Foundation and includes the participation of leading construction equipment distributors, equipment manufacturers and post-secondary school faculty. The standards cover six areas that the industry considers most important for the training of entry-level technicians:

- Safety/Administrative
- Electronics/Electrical
- Hydraulics/Hydrostatics
- Power Trains
- Diesel Engines
- Air Conditioning/Heating

Established in 1991, The AED Foundation is the educational affiliate of Associated Equipment Distributors (AED), an international association of the construction equipment industry representing over 700 independent distributor, manufacturer and related firms. AED was established in 1919. The National Center on Education and the Economy (NCEE), Washington, DC provided guidance for the development of the original standards. For more information or for additional copies, contact:

The AED Foundation  
600 Hunter Drive, Suite 220  
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Permission to copy this document for personal use by business and educational personnel is granted by The AED Foundation. This publication is available on-line at: <http://www.aedfoundation.org> <http://www.aedworkforce.com>

For more information related to implementing ASE Student Certification at your local campus, please visit <https://netforum.avectra.com/eWeb/StartPage.aspx?Site=AED&WebCode=HomePage>

## INDUSTRY JOB PROJECTION DATA

Bus and truck mechanics and diesel engine specialists' occupations require an education level of a postsecondary career and technical certificate. There is a 6.71% increase in occupational demand at the regional level and a 5.63% increase at the state level. Median annual income for diesel equipment technicians and mechanics is \$33,633.60 at the state level. A summary of occupational data from the State Workforce Investment Board Data Center is displayed below:

**Table 1: Education Level**

Program Occupations	Education Level
Bus and truck mechanics and diesel engine specialist	Postsecondary Career and Technical Award

**Table 2: Occupational Overview**

	Region	State	United States
2010 Occupational Jobs	1669	2114	221850
2020 Occupational Jobs	1781	2233	231980
Total Change	112	119	10130
Total % Change	6.71%	5.63%	4.57%
2010 Median Hourly Earnings	\$16.17	\$16.17	\$19.64
2010 Median Annual Earnings	\$33,633.60	\$33,633.60	\$40,851.20
Annual Openings	11	11	1013

**Table 3: Occupational Breakdown**

Description	2010 Jobs	2020 Jobs	Annual Openings	2010 Hourly Earnings	2010 Annual Earnings 2,080 Work Hours
Bus and truck mechanics and diesel engine specialists	1669	1781	11	\$16.17	\$33,633.60
<b>TOTAL</b>	<b>1669</b>	<b>1781</b>	<b>11</b>	<b>\$16.17</b>	<b>\$33,633.60</b>

**Table 4: Occupational Change**

Description	Regional Change	Regional % Change	State % Change	National % Change
Bus and truck mechanics and diesel engine specialists	112	6.71%	5.63%	4.57%

## ARTICULATION

Based on the complexity of the Diesel Equipment Technology, articulation will not be granted at the postsecondary level. Dual credit and partnerships are encouraged at the local level.

## TECHNICAL SKILLS ASSESSMENT

Students will be assessed using the Diesel Equipment Technology MS-CPAS2 test. All students will test after year one of their program. A second test targeting the transportation option second year material or the heavy equipment option second year material will be administered to AAS track students upon completion of their program.

Or

Upon completion of the transportation option of this program, students should be prepared to sit for the national or international assessment, *ASE Student Certification Medium/Heavy Truck Assessment* aligned with this curriculum or to take another alternative assessment approved by MCCB Office of Career and Technical Education.

Refer to the MCCB site for the latest approved alternate assessments.

## ONLINE AND BLENDED LEARNING OPPORTUNITIES

Course content includes lecture and laboratory semester credit hours. Faculty members are encouraged to present lecture related content to students in an online or blended learning environment. Training related to online and blended learning will be available to faculty members through the MS Community College Board.

## INSTRUCTIONAL STRATEGIES

The 2014 Medium/Heavy Truck ASE student certification task lists based on NATEF standards were adopted and provide instructional strategies to faculty members implementing the curriculum. The Construction Equipment Technology Standards provided from the Associated Equipment Distributors were also included in the curriculum and provide instructional strategies to faculty members implementing the curriculum.

## ASSESSMENT STRATEGIES

The NATEF Standards were adopted for the 2014 Medium/Heavy Truck ASE Student Certification Task Lists, along with the Construction Equipment Technology Standards, provided by the Accredited Equipment Distributors, and provide assessment strategies to faculty members implementing the curriculum. Additionally, performance tasks were included in course content when appropriate.

## CREDIT BY EXAMINATION

The following ASE student certification areas are aligned to courses listed below. Each area will serve as the state recommended exam to reward credit for prior learning experiences. Colleges have the local autonomy to create a college-level exam when awarding credit. This challenge exam, written and skill based, agreement will be made at local institution.

## PROGRAM DESCRIPTION

The Diesel Equipment Technology Program is an instructional program that provides students with competencies required to maintain and repair a variety of industrial diesel equipment, including agricultural tractors, commercial trucks, and construction equipment. The program includes instruction in inspection, repair, and maintenance of engines, power trains, hydraulic systems, and other components.

Diesel Equipment Technology is an articulated certificate or technical program designed to provide advanced skills to its students. Baseline competencies, taken from the secondary Diesel Service Technology, serve as a foundation for the competencies and objectives taught in the courses of the program. Students who do not possess these competencies will be allowed to acquire them during the program. Students who can document mastery of these baseline competencies will not be required to repeat these competencies.

The program offers an accelerated transition pathway of 15 semester credit hours, a career certificate at 30 semester credit hours, a technical certificate at 45 semester credit hours for transportation (medium to heavy trucks) option, a technical certificate at 45 semester credit hours for a heavy equipment option, and an Associate of Applied Science degree at 60 semester credit hours.

The curriculum utilized both the Automotive Service Excellence (ASE) *2014 Medium/Heavy Truck standards* and the *2014 Standards for Construction Equipment Technology* (AED). These documents serve as national standards for certification of medium/heavy truck and construction equipment technician programs.

The tasks described in the document are based on a number of assumptions which also apply to the competencies and objectives in the Career Technical courses of this program. These assumptions include:

1. In all areas, appropriate theory, safety, and support instruction will be required in the performance of each objective including the identification and safe use of tools and testing and measuring equipment, and the use of reference materials and technical manuals, whether electronic or paper-based.
2. All diagnostic and repair tasks are performed in accordance with manufacturer's recommended procedures and to manufacturer's specifications.

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Associated Equipment Distributors (Construction Equipment Technology)  
The AED Foundation  
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Oak Brook, IL 60523  
Phone: 630-574-0650 Fax: 630-574-0132

## SUGGESTED COURSE SEQUENCE

### Accelerated Transition Pathway

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Contact Hours	Contact Hour Breakdown		Certification Information
			Lecture	Lab		Lecture	Lab	Certification Name
DET 1114	Fundamentals of Equipment Mechanics	4	3	2	75	45	30	
DET 1614	Preventive Maintenance and Service	4	2	4	90	30	60	
	Electives	7						
<b>TOTAL</b>		<b>15</b>						

### Career Certificate Required Courses

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Contact Hours	Contact Hour Breakdown		Certification Information
			Lecture	Lab		Lecture	Lab	Certification Name
DET 1114	*Fundamentals of Equipment Mechanics	4	3	2	75	45	30	Forklifting Certification
DET 1223	*Electrical/Electronic Systems I	3	2	2	60	30	30	ASE
DET 1513	*Hydraulics I	3	1	4	75	15	60	
DET 1364	*Diesel Systems I	4	2	4	90	30	60	ASE
DET 1614	*Preventive Maintenance and Service	4	2	4	90	30	60	
DET 1263 or DET 1713	Electrical/Electronic Systems II or Transportation Power Train	3/3	1/2	4/2	75/60	15/30	60/30	ASE (DET 1263)
DET 1813	*Air Conditioning and Heating Systems	3	1	4	75	15	60	ASE & Section 609 Certification
DET 1374 or DET 2623	Diesel Systems II or Advanced Brake Systems	4/3	2/2	4/2	90/60	30/30	60/30	
	Approved electives per Instructor at local community college level	2						
<b>TOTAL</b>		<b>30</b>			<b>555</b>	<b>255</b>	<b>300</b>	

\*These courses will be tested on MS-CPAS2.

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**Technical Certificate Required Courses (Transportation Option)**

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Contact Hours	Contact Hour Breakdown		Certification Information
			Lecture	Lab		Lecture	Lab	
DET 2273	*Electrical/Electronic Systems III	3	1	4	75	15	60	ASE
DET 2253	*Steering and Suspension Systems	3	2	2	60	30	30	ASE
DET 1713	*Transportation Power Train	3	2	2	60	30	30	
DET 2623	*Advanced Brake Systems (Air)	3	2	2	60	30	30	ASE
	Instructor Approved Electives	3						
<b>TOTAL</b>		<b>15</b>			<b>375</b>	<b>105</b>	<b>270</b>	

\*These courses will be tested on MS-CPAS2.

**Note: Courses required under the Transportation Option MAY be used as electives for the Heavy Equipment Option.**

**Technical Certificate Required Courses (Heavy Equipment Option)**

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Contact Hours	Contact Hour Breakdown		Certification Information
			Lecture	Lab		Lecture	Lab	
DET 2273	*Electrical/Electronic Systems III	3	1	4	75	15	60	ASE
DET 2523	*Heavy Equipment Power Train	3	1	4	75	15	60	
DET 2513	*Hydraulic/Hydrostats II	3	2	2	60	30	30	ASE
DET 2383	*Diesel Systems III	3	2	2	60	30	30	ASE
	Instructor Approved Electives	3						
<b>TOTAL</b>		<b>15</b>			<b>375</b>	<b>105</b>	<b>270</b>	

\*These courses will be tested on MS-CPAS2.

**Note: Courses required under the Heavy Equipment Option MAY be used as electives for the Transportation Option.**

### General Education Core Courses

To receive the Associate of Applied Science Degree, a student must complete all of the required coursework found in the Career Certificate option, Technical Certificate option and a minimum of 15 semester hours of General Education Core. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester or provided primarily within the last semester. Each community college will specify the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college. The Southern Association of Colleges and Schools (SACS) Commission on Colleges Standard 2.7.3 from the Principles of Accreditation: Foundations for Quality Enhancement<sup>1</sup> describes the general education core.

Section 2.7.3 In each undergraduate degree program, the institution requires the successful completion of a general education component at the collegiate level that (1) is substantial component of each undergraduate degree, (2) ensures breadth of knowledge, and (3) is based on a coherent rationale. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours or the equivalent. These credit hours are to be drawn from and include at least one course from the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. The courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession.

### Academic Courses for Diesel Equipment Technology

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Credit Hours	Contact Hour Breakdown		Certification Information
			Lecture	Lab		Lecture	Lab	Certification Name
	Humanities/Fine Arts	3						
	Natural Science/Mathematics (MAT 1313 College Algebra*)	3						
	Social/Behavioral Sciences	3						
	Other academic courses per local community college requirements for AAS degree.	6						
<b>TOTAL</b>		<b>15</b>						

**\*MAT 1233 Intermediate Algebra may be taken in lieu of MAT 1313 College Algebra; This Mathematics course can be College Algebra or higher (MAT 1713)**

<sup>1</sup>

Southern Association of Colleges and Schools Commission on Colleges. (2012). *The principles of accreditation: Foundations for quality enhancement*. Retrieved from <http://www.sacscoc.org/pdf/2012PrinciplesOfAccreditation.pdf>

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**Technical Electives**

Course Number	Course Name	Semester Credit Hours	SCH Breakdown			Total Contact Hours	Contact Hour Breakdown			Certification Information
			Lecture	Lab	Clinical/ Internship		Lecture	Lab	Clinical/ Internship	Certification Name
DET 1213	Hydraulic Brake Systems	3	2	2		60	30	30		
DET 2383	Diesel Systems III	3	2	2		60	30	30		
DET 291(1-6)	Special Problem/ Projects in Diesel Equipment Technology	1-6		2-12		30-180		30-180		
DET 292(1-3)	Supervised Work Experience in DET	1-3			1-3	15-45			15-45	
DET 2113	Welding for Diesel Equipment Technology	3	1	4		75	15	60		
DET 2523	Heavy Equipment Power Train	3	1	4		75	15	60		
WBL 191(1-3) WBL 192(1-3) WBL 193(1-3) WBL 291(1-3) WBL 292(1-3) WBL 293(1-3)	Work-Based Learning	1-6			3-18	45-270			45-270	
CPT 1113	Fundamentals of Microcomputer Applications	3								
CSC 1113	Introduction to Computer Concepts	3								
IMM 1935	Manufacturing Skills Basic	5								
	<b>Other Instructor Approved Elective(s)</b>									

## CAREER CERTIFICATE REQUIRED COURSES

**Course Number and Name:**            **DET 1114            Fundamentals of Equipment Mechanics**

**Classification:**                            Career Certificate Core Requirement

**Description:**                              This is a course designed to provide review and update of safety procedures; tools and equipment usage; handling, storing, and disposing of hazardous materials; and operating principles of diesel engines.

<b>Hour Breakdown:</b>	Semester Hours	Lecture	Lab	Contact Hours
	4	3	2	75

**National Assessment:**

**Prerequisite:**                                None

**Student Learning Outcomes:**

1. Describe general safety rules for working in a shop/lab and industry.
  - a. Describe how to avoid on-site accidents.
  - b. Explain the relationship between housekeeping and safety, the importance of following all safety rules and company safety policies, the importance of reporting all on-the-job injuries and accidents, the need for evacuation policies and the importance of following them, the employer’s substances abuse policy and how it relates to safety.
  - c. Explain the safety procedures when working near pressurized fluids or high temperature.
  
2. Use proper safety practices when performing diesel repair operations.
  - a. Recognize, inspect, and explain personal protective equipment.
  
3. Identify and explain the procedures for lifting heavy objects.
  
4. Explain the Material Safety Data Sheet (MSDS).
  - a. Explain the function of the MSDS.
  - b. Interpret the requirements of the MSDS.
  
5. Explain fires.
  - a. Explain the process by which fires start.
  - b. Explain fire prevention of various flammable liquids.
  - c. Explain the classes of fire and the types of extinguishers.
  
6. Explain electrical safety hazards, injuries, and precautions in and around diesel repair.
  
7. Demonstrate the proper use and interpretation of precision measurement instruments.
  
8. Introduce programs that promote continuous improvement of efficiencies in the workplace.

**AED Standards**

1. Demonstrate knowledge of the following:
  - 1a. Safety
    - 1a.1            Proper use of hand tools.
      - a. Identify and correctly name the basic hand tools.

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- b. Demonstrate the proper use of the designed application and safe operating procedure for each.
  - c. Demonstrate a proper source for calibration of precision hand tools.
- 1a.2 Use of electric tools
- a. Identify and correctly name the electrical tool.
  - b. Demonstrate the proper use of the designed application and safe operating procedure for each.
  - c. Demonstrate the proper inspection, care and storage for electric hand tools.
  - d. Understand and exhibit the safe and proper use of ground fault circuits.
- 1a.3 Use of air tools
- a. Identify and correctly name the basic air tool.
  - b. Demonstrate the proper use of the designed application and safe operating procedure for each.
  - c. Demonstrate the proper inspection, care, maintenance and storage for air tools.
- 1a.4 Use of hydraulic tools
- a. Identify and correctly name the basic hydraulic tools.
  - b. Demonstrate the proper inspection, care, maintenance, and storage as applicable.
  - c. Demonstrate the proper use of the designed application and safe operating procedure as applicable.
- 1a.5 Use of lifting equipment
- a. Identify and correctly name the various types of lifting equipment.
  - b. Demonstrate the proper inspection, care, maintenance, and storage for each.
  - c. Demonstrate the proper use of the designed application and safe operating procedure for each.
  - d. Understand current regulations and standards for use, inspection and certification of lifting equipment.
  - e. Identify and correctly name the basic cleaning equipment used in our industry.
  - f. Complete Forklifting Operation and Certification (Forklifting Certification)
- 1a.6 Use of various cleaning equipment
- a. Demonstrate the proper use of the designed application and safe operating procedures for each.
  - b. Demonstrate the proper inspection, care, maintenance, and storage for cleaning equipment.
  - c. Identify the various solvents and solutions used in the cleaning process.
  - d. Identify the risks, hazards and precautions for cleaning materials, both personal and environmental.
  - e. Demonstrate an understanding of Safety Data Sheets (SDS) and requirements to meet OSHA standards.
- 1a.7 Use of fluid pressure testing equipment
- a. Identify and correctly name the various types of fluid pressure test equipment and the accessories required for proper testing.
  - b. Explain the proper use of the designed application and safe operation of each type of equipment.
  - c. Demonstrate a proper source for calibration of precision test equipment and accessories.
  - d. Identify, correctly name and demonstrate the use of the personal protective equipment required for the various types of fluid pressure testing equipment.
  - e. Explain at least three dangers of working with fluids under pressure.
- 1a.8 Environment of service facility
- a. Identify the various types of exhaust systems used in repair facility.
  - b. Demonstrates the proper use of the designed application and safe operation of each type of

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- system.
  - d. Demonstrate the proper inspection, care, maintenance and storage of the systems and the equipment required for operation.
  - e. Explain why carbon monoxide and diesel smoke can be hazardous to your health and the precautions required for eliminating injury or death.
  - f. Recognize symptoms of exposure to carbon monoxide, diesel smoke and other hazardous materials.
- 1a.9 Machine identification and operation
- a. Can identify the various types of construction equipment and forklifts, using the standard industry names accepted by equipment manufacturers.
  - b. Demonstrates and can explain the proper, safe and fundamental operation of the various types of machinery.
  - c. Understand from a user's perspective the importance of and reasons for caution/warning lights, backup alarms, seat belts, safety instructions, decals and other customer-related safety information.
  - d. Recognize hybrid systems and/or machines as they relate to safety concerns.
- 1a.10 Mandated Regulations
- a. Understand and identify underground utility hazard marking that would commonly be encountered on a job site.
  - b. Explain why working safely is important, and explain the procedures for reporting unsafe working conditions and practices.
- 1a.11 Shop and in-field practices
- a. Can identify safe work practices in each situation.
  - b. Can demonstrate safe work practices in the shop or in the field.
  - c. Can identify proper lifting and pulling techniques to avoid personal injury.
  - d. Demonstrate proper lifting and pulling techniques.
  - e. Demonstrate proper shop/facility cleanliness/appearance to dealer standards.
- 1a.12 Hazard identification and prevention
- a. Demonstrate safe mounting and dismounting practices on construction machinery.
  - b. Explain proper types of chains and binders used in securing loads.
  - c. Demonstrate proper lock out tag out procedures.
  - d. Demonstrate understanding of the HazCom standard and how to use Safety Data Sheets and Chemical Labels.
  - e. Write about or discuss from personal or team experience (shop, workplaces, etc.,) common safety hazards and what you would have done to eliminate them.
- 1b. Administrative
- 1b.1 Comprehend basic academic functions
- a. Exhibit the ability to use parts and service reference/technical materials, and safety materials in print or computer format.
  - b. Exhibit the ability to follow written instructions.
  - c. Exhibit the ability to complete forms, time cards, work orders, accident reports, sales leads, technical bulletins, parts requisitions, and other related written forms of communication.
  - d. Exhibit the ability to perform basic math functions, including measurement in both U.S. and metric, calculations, conversions, and currency.
- 1b.2 Utilize industry software and electronic communications systems and reference resources
- a. Develop and exhibit good listening skills.
  - b. Exhibit the ability to use a computer, and related hardware, current software, Internet, and technology currently in use.
  - c. Demonstrate efficient, effective, correct and timely communications to a customer and co-

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worker utilizing telephone, fax, computer, word processing and E-mail.

- d. Using a computer, demonstrate the ability to retrieve specifications, part numbers, bulletins, schematics, produce reports, and similar types of information using manufacturers' software and internet based resources.

### 5. Diesel Engines

#### 5.1 Safety

- a. Understand safety instruction specifically related to engine applications, including OSHA regulations.

#### 5.2 Identification and use of basic tools

- a. Review assignments, evaluation of identification exercises. Written exams that will determine the competency on many items unable to check by hands-on exercises. Emphasis on safety should be demonstrated with all tool usage.
- b. Understand performance testing of tool/equipment to check comprehension. Demonstrate all torque and de-torque methods with hands-on exercises.
- c. Read accurately all precision measuring tools and gauges.
- d. Demonstrate the ability to convert standard to and from metric measurements, both pressure and distance.
- e. Determine engine speed and pulses per revolution.
- f. Understand tasks related to measuring, understanding and recording pressure, flows and temperature.
- g. Demonstrate tasks related to measuring specific gravity of fuel, coolant and electrolyte.

#### 5.3 Theory and operation

- a. Demonstrated the application of engine theory of operation. Written tests designed for this purpose.
- b. Understanding and comprehension of formulas to calculate engine performance criteria.
- c. Understand the relationship between engine HP and torque.
- d. Know the differences between spark ignited and compression ignition engines.
- e. Determine engine/component motion and speed ratios.
- f. Explain diesel 4-stroke engine cycle.
- g. Memorize the order of strokes. Identify the specific stroke of each cylinder during engine rotation.
- h. Determine the number of degrees between power strokes on various engines.
- i. Understand diesel combustion principles, and the effects of pre-ignition, detonation and misfire.
- j. Demonstrate glow plug operation & testing.
- k. Determine engine rotation by valve overlap.
- l. Identify the various combustion chambers and know the advantages/disadvantages of each type.
- m. Perform basic valve and injection timing tasks.
- n. Understand the theory of injection pump timing.
- o. Understand the functions of various cooling system components.
- p. Understanding measurement and properties of the engine fluids.
- q. Understand cross contamination root causes and effects of each.
- r. Understand the functions and components of diesel engine lubrication systems and the effects of machine operating angle.
- s. Understand effects of lubrication system levels (over and under

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**Course Number and Name:**        **DET 1223        Electrical/Electronic Systems I**

**Classification:**                      Career Certificate Core Requirement

**Description:**                         This is a course designed to provide diagnosis, service, and repair of electrical and electronic systems on diesel engines, includes instruction in general systems diagnosis, starting and charging systems.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	2	2	60

**National Assessment:**

**Prerequisite:**                         Instructor Approved

**Student Learning Outcomes:**

1. Explore general electronic and electrical systems.
  - a. Read and interpret electrical/electronic circuits using wiring diagrams.
  - b. Check continuity in electrical/electronic circuits using appropriate test equipment.
  - c. Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using appropriate test equipment.
  - d. Check current flow in electrical/electronic circuits and components using appropriate test equipment.
  - e. Check resistance in electrical/electronic circuits and components using appropriate test equipment.
  - f. Locate shorts, grounds, and opens in electrical/electronic circuits.
  - g. Identify parasitic (key-off) battery drain problems; perform tests; determine needed action.
  - h. Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed.
  - i. Inspect and test spike suppression devices; replace as needed.
  
2. Discuss and perform battery diagnosis and repair.
  - a. Perform battery load test; determine needed action.
  - b. Determine battery state of charge using an open circuit voltage test.
  - c. Inspect, clean, and service battery; replace as needed.
  - d. Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed.
  - e. Charge battery using slow or fast charge method as appropriate.
  - f. Inspect, test, and clean battery cables and connectors; repair or replace as needed.
  - g. Jump start a vehicle using jumper cables and a booster battery or appropriate auxiliary power supply using proper safety procedures.
  - h. Perform battery capacitance test; determine needed action.
  
3. Discuss and perform starting system diagnosis and repair.
  - a. Perform starter circuit cranking voltage and voltage drop tests; determine needed action.
  - b. Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed.
  - c. Inspect and test starter relays and solenoids/switches; replace as needed.
  - d. Remove and replace starter; inspect flywheel ring gear or flex plate.

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4. Discuss and perform charging system diagnosis and repair.
  - a. Test instrument panel mounted volt meters and/or indicator lamps; determine needed action.
  - b. Identify causes of a no charge, low charge, or overcharge problems; determine needed action.
  - c. Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment.
  - d. Perform charging system voltage and amperage output tests; perform AC ripple test; determine needed action.
  - e. Perform charging circuit voltage drop tests; determine needed action.
  - f. Remove and replace alternator.
  - g. Inspect, repair, or replace cables, wires, and connectors in the charging circuit.
  
5. Discuss digital multi-meter usage and operation.

### AED Standards

Demonstrate knowledge of the following:

#### 2. Electronics/Electrical Systems

##### 2.1 Fundamental Knowledge

- a. Know the basic structure of conductors, insulators, and semi-conductors.
- b. Know the reaction of like and unlike charges.
- c. Describe the differences of conventional and electron theory current flow.
- d. Define resistance and its effect on current flow.
- e. Demonstrate the principles of operation and the correct usage of the various types of meters to measure volts, amps, and ohms.
- f. Demonstrate ability to convert between kilo, milli, and micro units.
- g. Demonstrate knowledge of the laws governing permanent magnets, electromagnets, and magnetic fields.
- h. Demonstrate knowledge of the effects of magnetic forces on current carrying conductors.
- i. Know the basic parts and operation of the basic types of storage batteries.
- j. Understand remote monitoring systems and the ability to remotely diagnose electrical/electronic issues.

##### 2.2 Ohm's law

- a. Demonstrate the mathematical relationship of the various terms in ohms law as they pertain to series, parallel, and series-parallel circuits.
- b. Demonstrate the ability to set-up and measure the voltage, amperage, and resistance values in series, parallel, and series/parallel DC circuits.

##### 2.3 12/24 volt cranking circuits

- a. Know the basic components that make up the various types of 12/24 volt cranking systems.
- b. Demonstrate the sequence of operation of the components contained within a cranking system. The emphasis is on how each component effects the system's overall operation.
- c. Demonstrate the ability to isolate problems using voltage drops and other diagnostic methods. The proper use of testing equipment is paramount.
- d. Demonstrate the ability to properly test, evaluate and replace the following components using manufacturers' service publications and specifications.
  1. Conductors
  2. Relays/ Solenoids
  3. Starters

##### 2.4 12/24 volt charging circuits

- a. Know the basic components that make up the various types of 12/24 volt charging systems.
- b. Demonstrate the sequence of operation of the components contained within a charging system. The emphasis is on how each component effects the system's overall operation.

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- c. Demonstrate the ability to isolate problems using voltage drops and other diagnostic methods. The proper use of testing equipment is paramount.
- d. Demonstrate the ability to properly test, evaluate and replace the following components using manufacturers' service publications and specifications.
  1. Conductors
  2. Alternators
  3. Regulators

### ASE Student Certifications

#### *Electrical/Electronic Systems*

##### A. General Electrical Systems

1. Read and interpret electrical/electronic circuits using wiring diagrams.
2. Check continuity in electrical/electronic circuits using appropriate test equipment.
3. Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using appropriate test equipment.
4. Check current flow in electrical/electronic circuits and components using appropriate test equipment.
5. Check resistance in electrical/electronic circuits and components using appropriate test equipment.
6. Locate shorts, grounds, and opens in electrical/electronic circuits.
7. Identify parasitic (key-off) battery drain problems; perform tests; determine needed action.
8. Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed.
9. Inspect and test spike suppression devices; replace as needed.
10. Check frequency and pulse width signal in electrical/electronic circuits using appropriate test equipment.

##### B. Battery

1. Perform battery load test; determine needed action.
2. Determine battery state of charge using an open circuit voltage test.
3. Inspect, clean, and service battery; replace as needed.
4. Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed.
5. Charge battery using slow or fast charge method as appropriate.
6. Inspect, test, and clean battery cables and connectors; repair or replace as needed.
7. Jump start a vehicle using jumper cables and a booster battery or appropriate auxiliary power supply using proper safety procedures.
8. Perform battery capacitance test; determine needed action.

##### C. Starting System

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

##### D. Charging System Diagnosis and Repair

1. Test instrument panel mounted volt meters and/or indicator lamps; determine needed action.
2. Identify causes of a no charge, low charge, or overcharge problems; determine needed action.
3. Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment.
4. Perform charging system voltage and amperage output tests; perform AC ripple test; determine needed action.
5. Perform charging circuit voltage drop tests; determine needed action.
6. Remove and replace alternator.
7. Inspect, repair, or replace cables, wires, and connectors in the charging circuit.

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**Course Number and Name:**                **DET 1263    Electrical/Electronic Systems II**

**Classification:**                                Career Certificate Core Requirement

**Description:**                                    This is a course designed to provide diagnosis, service, and repair of electrical and electronic systems on diesel engines, includes instruction on lighting systems, gauges and warning devices, and related electrical systems.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	1	4	75

**National Assessment:**

**Prerequisite:**                                    Instructor Approved

**Student Learning Outcomes:**

1. Explore headlights, daytime running lights, parking, clearance, tail, cab, and instrument panel lights.
  - a. Identify causes of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation.
  - b. Test, aim, and replace headlights.
  - c. Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets and control components; repair or replace as needed.
  - d. Inspect and test switches, bulbs/LEDs, sockets, connectors, terminals, relays, wires, and control components/modules of parking, clearance, and taillight circuits; repair or replace as needed.
  - e. Inspect and test instrument panel light circuit switches, relays, bulbs/LEDs, sockets, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed.
  - f. Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, wires, and control components/modules; repair or replace as needed.
  - g. Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed.
  
2. Discuss and perform stoplight, turn signal, hazard light, and back-up light diagnosis and repair.
  - a. Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed.
  - b. Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed.
  - c. Inspect and test reverse lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, wires and control components/modules; repair or replace as needed.
  
3. Discuss and perform gauge and warning device diagnosis and repair.
  - a. 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.
  - b. Identify causes of intermittent, high, low, or no gauge readings; determine needed action.
  - c. Identify causes of data bus-driven gauge malfunctions; determine needed action.
  - d. Inspect and test gauge circuit sensor/sending units, gauges, connectors, terminals, and wires; repair or replace as needed.
  - e. Inspect and test warning devices (lights and audible) circuit sensor/sending units, bulbs/LEDs, sockets, connectors, wires, and control components/modules; repair or replace as needed.
  - f. Inspect, test, replace, and calibrate (if applicable) electronic speedometer, odometer, and tachometer systems.

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4. Discuss and perform related electrical system diagnosis and repair.
  - a. 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.
  - b. Identify causes of constant, intermittent, or no horn operation; determine needed action.
  - c. Inspect and test horn circuit relays, horns, switches, connectors, wires, and control components/modules; repair or replace as needed.
  - d. Identify causes of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems; determine needed action.
  - e. Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, wires and control components/modules; repair or replace as needed.
  - f. Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed.
  - g. Inspect and test windshield washer motor or pump/relay assembly, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed.
  - h. Inspect and test sideview mirror motors, heater circuit grids, relays, switches, connectors, terminals, wires and control components/modules; repair or replace as needed.
  - i. Inspect and test heater and A/C electrical components including: A/C clutches, motors, resistors, relays, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed.
  - j. Inspect and test auxiliary power outlet, integral fuse, connectors, terminals, wires, and control components/modules; repair or replace as needed.
  - k. Identify causes of slow, intermittent, or no power side window operation; determine needed action.
  - l. Inspect and test motors, switches, relays, connectors, terminals, wires, and control components/modules of power side window circuits; repair or replace as needed.
  - m. Inspect and test block heaters; determine needed repairs.
  - n. Inspect and test cruise control electrical components; repair or replace as needed.
  - o. Inspect and test switches, relays, controllers, actuator/solenoids, connectors, terminals, and wires of electric door lock circuits
  - p. Check operation of keyless and remote lock/unlock devices; determine needed action.
  - q. Inspect and test engine cooling fan electrical control components/modules; repair or replace as needed.
  - r. Identify causes of data bus communication problems; determine needed action.

### AED Standards

Demonstrate knowledge of the following:

#### 2. Electronics/Electrical Systems

##### 2.5 Lighting, accessory and control systems

- a. Know the basic components that make up the various types of lighting, accessory and control systems.
- b. Demonstrate the sequence of operation of the components contained within various lighting, accessory and control systems. The emphasis is on how each component effects the system's overall operation.
- c. Demonstrate the ability to isolate problems within various lighting, accessory and control systems using voltage drops and other diagnostic methods. The proper use of testing equipment is paramount.
- d. Demonstrate the ability to properly disassemble, test, assemble, replace, or repair lighting, accessory and control system components using manufacturers' service publications and specifications. Examples of the components are as follows:
  1. Wiring harness/connectors
  2. Fuses/circuit breakers
  3. Lights/bulbs
  4. Electromagnetic devices
  5. Gauges
  6. Meters
  7. Horns and buzzers

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8. Relays
9. Diodes
10. Resistors
11. Potentiometers
12. Solenoids
13. Rheostats
14. Switches
15. Electric motors
16. Transformers/converters
17. Pre-heat devices - ie Glow plugs, intake heaters
18. Sensors
19. Monitors
20. Controllers
21. HID/LED
22. Transducers
23. Transistors

### ASE Student Certification Standards

#### *Electrical/Electronic Systems*

##### E. Lighting Systems

1. 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.
2. Identify causes of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation.
3. Test, aim, and replace headlights.
4. Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets, and control components/modules; repair or replace as needed.
5. Inspect and test switches, bulbs/LEDs, sockets, connectors, terminals, relays, wires, and control components/modules of parking, clearance, and taillight circuits; repair or replace as needed.
6. Inspect and test instrument panel light circuit switches, relays, bulbs/LEDs, sockets, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed.
7. Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, wires, and control components/modules; repair or replace as needed.
8. Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed.
9. Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed.
10. Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed.
11. Inspect and test reverse lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, wires and control components/modules; repair or replace as needed.

##### F. Gauges and Warning Devices

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.
2. Identify causes of intermittent, high, low, or no gauge readings; determine needed action.
3. Identify causes of data bus-driven gauge malfunctions; determine needed action.
4. Inspect and test gauge circuit sensor/sending units, gauges, connectors, terminals, and wires; repair or replace as needed.
5. Inspect and test warning devices (lights and audible) circuit sensor/sending units, bulbs/LEDs, sockets, connectors, wires, and control components/modules; repair or replace as needed.
6. Inspect, test, replace, and calibrate (if applicable) electronic speedometer, odometer, and tachometer systems.

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**Course Number and Name:**        **DET 1364**        **Diesel Systems I**

**Classification:**                      Career Certificate Core Requirement

**Description:**                        This is a course designed to provide diagnosis, service, and repair of basic engine operating principles, with an emphasis on cylinder head and valve train engine block.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
4	2	4	90

**National Assessment:**

**Prerequisite:**                        Instructor Approved

**Student Learning Outcomes:**

2. Explore cylinder head and valve train diagnosis and repair.
  - a. Remove, clean, inspect for visible damage, and replace cylinder head(s) assembly.
  - b. Clean and inspect threaded holes, studs, and bolts for serviceability; determine needed action.
  - c. Inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action.
  - d. Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action.
  - e. Measure valve head height relative to deck and valve face-to-seat contact; determine needed action.
  - f. Inspect injector sleeves and seals; measure injector tip or nozzle protrusion; determine needed action.
  - g. Inspect and adjust valve bridges (crossheads) and guides; perform needed action.
  - h. Reassemble cylinder head.
  - i. Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash.
  - j. Inspect pushrods, rocker arms, rocker arm shafts, electronic wiring harness, and brackets for wear, bending, cracks, looseness, and blocked oil passages; determine needed action.
  - k. Inspect cam followers; determine needed action.
  - l. Adjust valve bridges (crossheads); adjust valve clearances and injector settings.
  
3. Discuss and perform engine block diagnosis and repair.
  - a. Perform crankcase pressure test; determine needed action.
  - b. Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components.
  - c. Disassemble, clean, and inspect engine block for cracks/damage; measure mating surfaces for warpage; check condition of passages, core/expansion and gallery plugs; inspect threaded holes, studs, dowel pins, and bolts for serviceability; determine needed action.
  - d. Inspect cylinder sleeve counter-bore and lower bore; check bore distortion; determine needed action.
  - e. Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed action.
  - f. Replace/reinstall cylinder liners and seals; check and adjust liner height (protrusion).
  - g. Inspect in-block camshaft bearings for wear and damage; determine needed action.
  - h. Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play.
  - i. Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action.
  - j. Inspect main bearings for wear patterns and damage; replace as needed; check bearing clearances; check and correct crankshaft end play.
  - k. Inspect, install, and time gear train; measure gear backlash; determine needed action.
  - l. Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings; perform needed action.

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- m. Determine piston-to-cylinder wall clearance; check ring-to-groove fit and end gap; install rings on pistons.
- n. Assemble pistons and connecting rods; install in block; install rod bearings and check clearances.
- o. Check condition of piston cooling jets (nozzles); determine needed action.
- p. Inspect and measure crankshaft vibration damper; determine needed action.
- q. Install and align flywheel housing; inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action.
- r. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action.

### ASE Student Certification Standards

#### *Diesel Engines*

##### A. General

- 1. Inspect fuel, oil, and coolant levels, and condition; determine needed action.
- 2. Identify the causes of engine fuel, oil, coolant, air, and other leaks; determine needed action.
- 3. Listen for engine noises; determine needed action.
- 4. Observe engine exhaust smoke color and quantity; determine needed action.
- 5. Identify causes of no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action.
- 6. Identify causes of surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action.
- 7. Identify engine vibration problems; determine needed action.
- 8. Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; verify customer programmable parameters; clear codes; determine further diagnosis.

##### B. Cylinder Head and Valve Train

- 1. Remove, clean, inspect for visible damage, and replace cylinder head(s) assembly.
- 2. Clean and inspect threaded holes, studs, and bolts for serviceability; determine needed action.
- 3. Inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action.
- 4. Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action.
- 5. Measure valve head height relative to deck and valve face-to-seat contact; determine needed action.
- 6. Inspect injector sleeves and seals; measure injector tip or nozzle protrusion; determine needed action.
- 7. Inspect valve train components; determine needed action.
- 8. Reassemble cylinder head.
- 9. Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash.
- 10. Inspect electronic wiring harness and brackets for wear, bending, cracks, and looseness; determine needed action.
- 11. Adjust valve bridges (crossheads); adjust valve clearances and injector settings.

##### C. Engine Block

- 1. Perform crankcase pressure test; determine needed action.
- 2. Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components.
- 3. Check condition of piston cooling jets (nozzles); determine needed action.
- 4. Inspect and measure crankshaft vibration damper; determine needed action.
- 5. Install and align flywheel housing; inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action.
- 6. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action.

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**Course Number and Name:**            **DET 1374        Diesel Systems II**

**Classification:**                            Technical Certificate Core Requirement

**Description:**                              This is a course designed to provide skills and knowledge related to the diagnosis, service, and repair of lubrication systems, cooling system, and air induction and exhaust systems.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
4	2	4	90

**National Assessment:**

**Prerequisite:**                              Instructor Approved

**Student Learning Outcomes:**

1. Discuss and perform lubrication systems diagnosis and repair.
  - a. Test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit; test engine oil temperature and check operation of temperature sensor; determine needed action.
  - b. Check engine oil level, condition, and consumption; determine needed action.
  - c. Inspect and measure oil pump, drives, inlet pipes, and pick-up screens; check drive gear clearances; determine needed action.
  - d. Inspect oil pressure regulator valve(s), by-pass and pressure relief valve(s), oil thermostat, and filters; determine needed action.
  - e. Inspect, clean, and test oil cooler and components; determine needed action.
  - f. Inspect turbocharger lubrication and cooling systems; determine needed action.
  - g. Determine proper lubricant and perform oil and filter change.
  
2. Discuss and perform cooling system diagnosis and repair.
  - b. Test coolant temperature and check operation of temperature and level sensors, gauge, and/or sending unit; determine needed action.
  - c. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment.
  - d. Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed.
  - e. Recover, flush, and refill with recommended coolant/additive package; bleed cooling system.
  - f. Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed.
  - g. Inspect water pump and hoses; replace as needed.
  - h. Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed.
  
3. Discuss and perform air induction and exhaust systems diagnosis and repair.
  - a. Perform air intake system restriction and leakage tests; determine needed action.
  - b. Perform intake manifold pressure (boost) test; determine needed action.
  - c. Perform exhaust back pressure test; determine needed action.
  - d. Inspect turbocharger(s), wastegate, and piping systems; determine needed action.
  - e. Inspect and test turbocharger(s) (variable ratio/geometry VGT), pneumatic, hydraulic, electronic controls, and actuators.
  - f. Check air induction system: piping, hoses, clamps, and mounting; service or replace air filter as needed.
  - g. Remove and reinstall turbocharger/wastegate assembly.
  - h. Inspect intake manifold, gaskets, and connections; replace as needed.
  - i. Inspect, clean, and test charge air cooler assemblies; inspect aftercooler assemblies; replace as needed.

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- j. Inspect exhaust manifold, piping, mufflers, and mounting hardware; repair or replace as needed.
  - k. Inspect exhaust after treatment devices; determine necessary action.
  - l. Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action.
  - m. Inspect and test exhaust gas recirculation (EGR) system including EGR valve, cooler, piping, filter, electronic sensors, controls, and wiring; determine needed action.
4. Discuss EPA Requirements.
- a. Discuss history of the impact that EPA Requirements have on industry.
  - b. Discuss the pollutants that are regulated.
  - c. Discuss fuel and lubricant differences.
  - d. Understand the penalties for noncompliance of EPA Requirements.
  - e. Understand the role of DEF (Diesel Exhaust Fluid) in emissions compliance.
  - f. Understand the differences in operation and maintenance.

### AED Standards

Demonstrate knowledge of the following:

#### 5. Diesel Engines

##### 5.5 Component repair

- a. Practical exercises in parts reusability procedures and guidelines.
- b. Understanding industry remanufactured component guidelines and how to determine when to use remanufactured components.
- c. Be able to remove and replace commonly serviced external components. Know the inspection, service, and cleaning techniques associated with replacement of these items.

##### 5.6 Engine subsystems

- a. Locate and identify various external components.
- b. Knowledge of vibration fundamentals.
  - Linear characteristics
  - Rotational characteristics
- c. Understanding of the basic theory of exhaust after treatment systems like:
  - Diesel Particulate Filters (DPF)
  - Diesel Oxidation Catalyst (DOC)
  - Selective Catalytic Reduction (SCR)
  - Diesel exhaust fluid (DEF)
  - Regeneration process

### ASE Student Certification Standards

#### *Diesel Engines*

##### D. Lubrication Systems

- 1. Test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit; test engine oil temperature and check operation of temperature sensor; determine needed action.
- 2. Check engine oil level, condition, and consumption; determine needed action.
- 3. Inspect and measure oil pump, drives, inlet pipes, and pick-up screens; check drive gear clearances; determine needed action.
- 4. Inspect oil pressure regulator valve(s), by-pass and pressure relief valve(s), oil thermostat, and filters; determine needed action.
- 5. Inspect, clean, and test oil cooler and components; determine needed action.
- 6. Inspect turbocharger lubrication and cooling systems; determine needed action.
- 7. Determine proper lubricant and perform oil and filter change.

##### E. Cooling System

- 1. Check engine coolant type, level, condition, and consumption; test coolant for freeze protection and additive package concentration; determine needed action.
- 2. Test coolant temperature and check operation of temperature and level sensors, gauge, and/or sending unit; determine needed action.

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3. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment.
4. Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed.
5. Recover, flush, and refill with recommended coolant/additive package; bleed cooling system.
6. Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed.
7. Inspect water pump and hoses; replace as needed.
8. Inspect, clean, and pressure test radiator, pressure cap, tank(s), and recovery systems; determine needed action.
9. Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed.

### F. Air Induction, Exhaust Systems and Engine Brakes

1. Perform air intake system restriction and leakage tests; determine needed action.
2. Perform intake manifold pressure (boost) test; determine needed action.
3. Perform exhaust back pressure test; determine needed action.
4. Inspect turbocharger(s), wastegate, and piping systems; determine needed action.
5. Inspect and test turbocharger(s) (variable ratio/geometry VGT), pneumatic, hydraulic, electronic controls, and actuators.
6. Check air induction system: piping, hoses, clamps, and mounting; service or replace air filter as needed.
7. Remove and reinstall turbocharger/wastegate assembly.
8. Inspect intake manifold, gaskets, and connections; replace as needed.
9. Inspect, clean, and test charge air cooler assemblies; inspect aftercooler assemblies; replace as needed.
10. Inspect exhaust manifold, piping, mufflers, and mounting hardware; repair or replace as needed.
11. Inspect exhaust after treatment devices; determine necessary action.
12. Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action.
13. Inspect and test exhaust gas recirculation (EGR) system including EGR valve, cooler, piping, filter, electronic sensors, controls, and wiring; determine needed action.
14. Inspect and adjust engine compression/exhaust brakes; determine needed action.
15. Inspect, test, and adjust engine compression/exhaust brake control circuits, switches, and solenoids; repair or replace as needed.
16. Inspect engine compression/exhaust brake housing, valves, seals, lines, and fittings; repair or replace as needed.

### G. Fuel System

#### 1. Fuel Supply System

1. Check fuel level, and condition; determine needed action.
2. Perform fuel supply and return system tests; determine needed action.
3. Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determine needed action.
4. Inspect, clean, and test fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates, and mounting hardware; determine needed action.
5. Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determine needed action.
6. Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump.

## VALIDATION COPY

**Course Number and Name:**        **DET 1513        Hydraulics I**

**Classification:**                      Technical Certificate Core Requirement

**Description:**                         This is a course designed to provide knowledge of basic operation and maintenance of hydraulic systems associated with diesel powered equipment, includes instruction in safety, system components, operation, and repair.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	1	4	75

**National Assessment:**

**Prerequisite:**                         Instructor Approved

**Student Learning Outcomes:**

1. Explore general hydraulic system operation.
  - a. Identify system type (closed and open) and verify proper operation.
  - b. Read and interpret system diagrams, schematics, and symbols.
  - c. Perform system temperature, pressure, flow, and cycle time tests; determine needed action.
  - d. Verify placement of equipment /component safety labels and placards; determine needed action.
  
2. Discuss and perform pump operation, diagnosis, and repair.
  - a. Verify proper fluid type.
  - b. Identify causes of pump failure, unusual pump noises, temperature, flow, and leakage problems; determine needed action.
  - c. Determine pump type, rotation, and drive system.
  - d. Remove and install pump; prime and/or bleed system.
  - e. Inspect pump inlet and outlet for restrictions and leaks; repair as needed.
  
3. Discuss filtration/ reservoirs (tanks).
  - a. Identify type of filtration system; verify filter application and flow direction.
  - b. Service filters and breathers.
  - c. Identify causes of system contamination; determine needed action.
  - d. Take a hydraulic oil sample.
  - e. Check reservoir fluid level and condition; determine needed action.
  - f. Inspect and repair or replace reservoir, sight glass, vents, caps, mounts, valves, screens, supply and return lines.
  
4. Discuss hoses, fittings, and connections.
  - a. Diagnose causes of component leakage, damage, and restriction; determine needed action.
  - b. Inspect hoses and connections (length, size, routing, bend radii, and protection); repair or replace as needed.
  - c. Assemble hoses, tubes, connectors, and fittings in accordance with manufacturers' specifications; use proper procedures to avoid contamination.
  - d. Inspect and replace fitting seals and sealants.
  
5. Discuss and perform control valve diagnosis and repair.
  - a. Pressure test system safety relief valve; determine needed action.
  - b. Perform control valve operating pressure and flow tests; determine needed action.
  - c. Inspect, test, and adjust valve controls (electrical/electronic, mechanical, and pneumatic).
  - d. Identify causes of control valve leakage problems (internal/external); determine needed action.
  - e. Inspect pilot control valve linkages, cables, and PTO controls; adjust, repair, or replace as needed.

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6. Discuss actuators. [Comply with manufacturers' and industry accepted safety practices associated with equipment lock out/tag out; pressure line release; implement/support (blocked or resting on ground); and articulated cylinder devices/machinery safety locks.]
  - a. Identify actuator type (single/double acting, multi-stage/telescopic, and motors).
  - b. Identify the cause of seal failure; determine needed repairs.
  - c. Identify the cause of incorrect actuator movement and leakage (internal and external); determine needed repairs.
  - d. Inspect actuator mounting brackets and plates, frame components, and hardware for looseness, cracks, and damage; determine needed action.
  - e. Remove, repair, and/or replace actuators in accordance with manufacturers' recommended procedures.
  - f. Inspect actuators for dents, cracks, damage, and leakage; determine needed action.
  - g. Purge and/or bleed system in accordance with manufacturers' recommended procedures.

### AED Standards

- 3.1 Theory and operation, hydraulic and hydrostatic
  - a. Demonstrate knowledge that fluids have no shape of their own, are practically incompressible, apply equal pressure in all directions, and provide great increases in work force.
  - b. Demonstrate the understanding of the function of a reservoir, pump, filters, relief valve, control valve, and cylinder in relation to each other.
  - c. Know that open and closed center systems are determined by one or all of the following: a) the type of control valve, b) the type of pump, c) use of unloading valve, d) path of oil return to reservoir from pump.
  - d. Describe a basic, but complete, open center hydraulic system, explaining the operation of the system, the route of fluid during the use of a function, and the route of the fluid while the machine is running when no hydraulic function is being used.
  - e. Describe a basic, but complete, closed center load sensing hydraulic system, explaining the operation of the system, the route of fluid during the use of a function, and the route of the fluid while the machine is running when no hydraulic function is being used.
  - f. Be able to identify applications, and the benefits of those applications on construction equipment.
  - g. Demonstrate knowledge of hydrostatic systems, including closed-loop and open-loop systems.
  - h. Understand the various types of cooling circuits.
  - i. Understand the purpose of a charge circuit and how charge pressure relates to hydrostatic system efficiency.
  - j. Explain the differences between hydraulic and hydrostatic systems.
  - k. Be able to identify applications, and the benefits of those applications on construction equipment.
  - l. Explain the different characteristics between various types of pumps, exhibit the ability to follow the oil flow through each pump both while using a hydraulic function and with no hydraulic function being used.

**VALIDATION COPY**

**Course Number and Name:**            **DET 1614     Preventive Maintenance and Service**

**Classification:**                            Career Certificate Core Requirement

**Description:**                              This is a course designed to provide practice in the preventive maintenance of diesel powered equipment, includes instruction in general preventive maintenance of vehicles and equipment.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
4	2	4	90

**National Assessment:**

**Prerequisite:**                              Instructor Approved

**Student Learning Outcomes:**

1. Explore engine systems.
  - a. Discuss and perform equipment inspection diagnosis and repair.
    - 1) Check engine starting/operation (including unusual noises, vibrations, exhaust smoke, etc.); record idle and governed rpm.
    - 2) Inspect vibration damper, belts, tensioners, and pulleys; check and adjust belt tension; check belt alignment.
    - 4) Check engine oil level and condition; check dipstick seal.
    - 5) Inspect engine mounts for looseness and deterioration.
    - 6) Check engine for oil, coolant, air, fuel, and exhaust leaks (Engine Off and Running).
    - 7) Check engine compartment wiring harnesses, connectors, and seals for damage and proper routing.
  - b. Discuss and perform fuel system diagnosis and repair.
    - 1) Check fuel tanks, mountings, lines, caps, and vents.
    - 2) Drain water from fuel system, service water separator/fuel heater; replace fuel filter(s); prime and bleed fuel system.
  - c. Discuss and perform air induction and exhaust system diagnosis and repair.
    - 1) Check exhaust system mountings for looseness and damage and check engine exhaust system for leaks, proper routing, and damaged or missing components to include exhaust gas recirculation (EGR) system, and after-treatment devices, if equipped.
    - 3) Check air induction system: piping, charge air cooler, hoses, clamps, and mountings; check for air restrictions and leaks.
    - 4) Inspect turbocharger for leaks; check mountings and connections.
    - 5) Check operation of engine compression/exhaust brake.
    - 6) Service or replace air filter as needed; check and reset air filter restriction indicator.
    - 7) Inspect and service crankcase ventilation system.
    - 8) Check DEF (Diesel Exhaust Fluid) systems for leaks and fluid levels.
  - d. Discuss and perform cooling system diagnosis and repair.
    - 1) Check fan operation and inspect fan assembly and shroud.
    - 2) Inspect radiator (including air flow restriction, leaks, and damage) and mountings.
    - 4) Pressure test cooling system and radiator cap.
    - 5) Inspect coolant hoses and clamps and coolant recovery system
    - 7) Check coolant for contamination, additive package concentration, and protection level (freeze point).
    - 8) Service coolant filter.
    - 9) Inspect water pump for leaks and bearing play.
  - e. Discuss and perform lubrication system diagnosis and repair.
    - 1) Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs.
    - 2) Take an engine oil sample.

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2. Explore the cab and hood.
  - a. Discuss and perform instruments and control diagnosis and repair.
    - 1) Inspect key condition and operation of ignition switch.
    - 2) Check warning indicators and instruments; record oil pressure and system voltage.
    - 4) Check operation of electronic power take off (PTO) and engine idle speed controls (if applicable).
    - 5) Check (HVAC) controls.
    - 6) Check operation of all accessories.
    - 7) Using diagnostic tool or on-board diagnostic system; retrieve engine monitoring information; check and record diagnostic codes and trip/operational data (including engine, transmission, ABS, and other systems).
  - b. Discuss and perform safety equipment diagnosis and repair.
    - 1) Check operation of electric/air horns and reverse warning devices.
    - 2) Check condition of spare fuses, triangles, fire extinguisher, and all required decals.
    - 3) Inspect seat belts and sleeper restraints and check seat condition, operation, and mounting.
    - 4) Inspect wiper blades and arms and check operation of wiper and washer.
    - 6) Inspect windshield glass for cracks or discoloration; check sun visor.
    - 8) Check door glass and window operation.
    - 9) Inspect steps and grab handles.
    - 10) Inspect mirrors, mountings, brackets, and glass.
    - 11) Record all observed physical damage.
    - 12) Lubricate all cab and hood grease fittings and inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables.
    - 14) Inspect cab mountings, hinges, latches, linkages and ride height; service as needed.
  - c. Discuss and perform heating, ventilation, and air conditioning (HVAC) diagnosis and repair.
    - 1) Inspect A/C condenser, compressor and lines for condition and visible leaks; check mountings.
    - 3) Check A/C system condition and operation; check A/C monitoring system, if applicable.
    - 4) Check HVAC air inlet filters and ducts; service as needed.
  - d. Discuss and perform electrical/electronics diagnosis and repair.
    - 1) Inspect battery box(es), cover(s), and mountings and inspect battery hold-downs, connections, cables, and cable routing; service as needed.
    - 3) Check/record battery state-of-charge (open circuit voltage) and condition.
    - 4) Perform battery test (load and/or capacitance).
    - 5) Inspect starter, mounting, and connections and engage starter; check for unusual noises, starter drag, and starting difficulty.
    - 7) Inspect alternator, mountings, cable, wiring, and wiring routing; determine needed action and perform alternator output tests.
    - 9) Check operation of interior lights; determine needed action.
    - 10) Check all exterior lights, lenses, reflectors, and conspicuity tape; check headlight alignment; determine needed action.
    - 11) Inspect and test tractor-to-trailer multi-wire connector(s), cable(s), and holder(s); determine needed action.
3. Explore frame and chassis.
  - a. Discuss and perform air brake diagnosis and repair.
    - 1) Check operation of parking brake.
    - 2) Record air governor cut-out setting (psi) and check air governor cut-in pressure.
    - 3) Check operation of air reservoir/tank drain valve.
    - 4) Check air system for leaks (brakes released, then brakes applied).
    - 6) Test one-way and double-check valves.
    - 7) Check low air pressure warning devices.
    - 9) Check emergency (spring) brake control/modulator valve, if applicable.

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- 10) Check tractor protection valve.
  - 11) Test air pressure build-up time.
  - 12) Inspect coupling air lines, holders, and gladhands.
  - 13) Check brake chambers and air lines for secure mounting and damage.
  - 14) Check operation of air drier.
  - 15) Inspect and record brake shoe/pad condition, thickness, and contamination and Inspect record condition of brake drums/rotors.
  - 17) Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing.
  - 18) Check operation and adjustment of brake automatic slack adjusters (ASA); check and record push rod stroke.
  - 19) Lubricate all brake component grease fittings.
  - 20) Check condition and operation of hand brake (trailer) control valve.
  - 21) Perform antilock brake system (ABS) operational system self-test.
  - 22) Drain air tanks and check for contamination.
  - 23) Check condition of pressure relief (safety) valves.
- c. Discuss and perform drive train diagnosis and repair.
- 1) Check operation of clutch, clutch brake, and gearshift.
  - 2) Check clutch linkage/cable for looseness or binding, if applicable.
  - 3) Check hydraulic clutch slave and master cylinders, lines, fittings, and hoses, if applicable.
  - 4) Check clutch adjustment; adjust as needed.
  - 5) Check transmission case, seals, filter, hoses, and cooler for cracks and leaks.
  - 6) Inspect transmission breather.
  - 7) Inspect transmission mounts.
  - 8) Check transmission oil level, type, and condition.
  - 9) Inspect U-joints, yokes, driveshaft's, boots/seals, center bearings, and mounting hardware for looseness, damage, and proper phasing.
  - 10) Inspect axle housing(s) for cracks and leaks.
  - 11) Inspect axle breather(s).
  - 12) Lubricate all drive train grease fittings.
  - 13) Check drive axle(s) oil level, type, and condition.
  - 14) Change drive axle(s) oil and filter; check and clean magnetic plugs.
  - 15) Check transmission wiring, connectors, seals, and harnesses for damage and proper routing.
  - 16) Change transmission oil and filter; check and clean magnetic plugs.
  - 17) Check interaxle differential lock operation.
  - 18) Check range shift operation.
  - 19) Check swing bearing gearbox.
- d. Discuss and perform suspension and steering system diagnosis and repair.
- 1) Check steering wheel operation for free play or binding.
  - 2) Check power steering pump, mounting, and hoses for leaks, condition, and routing; check fluid level.
  - 3) Change power steering fluid and filter.
  - 4) Inspect steering gear for leaks and secure mounting and inspect steering shaft U-joints, pinch bolts, splines, pitman arm-to-steering sector shaft, tie rod ends, and linkages.
  - 6) Check kingpin for wear.
  - 7) Check wheel bearings for looseness and noise.
  - 8) Check oil level and condition in all non-drive hubs; check for leaks.
  - 9) Inspect springs, pins, hangers, shackles, spring U-bolts, and insulators.
  - 10) Inspect shock absorbers for leaks and secure mounting.
  - 11) Inspect air suspension springs, mounts, hoses, valves, linkage, and fittings for leaks and damage.
  - 12) Check and record suspension ride height.
  - 13) Lubricate all suspension and steering grease fittings.
  - 14) Check toe setting.

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- 15) Check tandem axle alignment and spacing.
- 16) Check axle locating components (radius, torque, and/or track rods).
- e. Discuss and perform tire and wheel diagnosis and repair.
  - 1) Inspect tires for wear patterns and proper mounting and inspect tires for cuts, cracks, bulges, and sidewall damage.
  - 3) Inspect valve caps and stems; replace as needed.
  - 4) Measure and record tread depth; probe for imbedded debris.
  - 5) Check and record air pressure; adjust air pressure in accordance with manufacturers' specifications.
  - 6) Check for loose lugs; check mounting hardware condition; service as needed.
  - 7) Re-torque lugs in accordance with manufacturers' specifications.
  - 8) Inspect wheels for cracks or damage.
  - 9) Check tire matching (diameter and tread) on dual tire installations.
  - 10) Adjust track tension.
- f. Discuss and perform frame and fifth wheel diagnosis and repair.
  - 1) Inspect fifth wheel mounting, bolts, air lines, and locks and test operation of fifth wheel locking device; adjust if necessary.
  - 3) Check quarter fenders, mud flaps, and brackets.
  - 4) Check pintle hook assembly and mounting.
  - 5) Lubricate all fifth wheel grease fittings and plate.
  - 6) Inspect frame and frame members for cracks and damage.

### AED Standards

Demonstrate knowledge of the following:

#### 3. Hydraulics/Hydrostatics

##### 3.3 Maintenance procedures

- a. Demonstrate familiarity with, and practice good hydraulic maintenance/safety practices.
- b. Perform all hydraulic functions and repairs in a clean atmosphere.
- c. Exhibit the ability to follow the proper flushing procedure using the correct technical manual/service information.
- d. Exhibit the proper maintenance techniques to prevent internal and external leaks.
- e. Demonstrate the procedure for cleaning hoses after cutting and crimping.
- f. Demonstrate knowledge of overheating conditions. Prevent overheating by keeping the oil at the proper levels, cleaning dirt and mud from around lines and cylinder rods, keep relief valves adjusted properly, do not overload or overspeed systems, and do not hold control valves in a position longer than necessary.
- g. Recognize the root causes of "blistering" or frayed hoses and procedures to avoid these problems.

**VALIDATION COPY**

**Course Number and Name:**        **DET 1713**        **Transportation Power Train**

**Classification:**                      Career Certificate Core Requirement

**Description:**                        This is a course designed to provide diagnosis, service, maintenance, and repair of power train units on transportation equipment, includes instruction on clutch, manual transmissions, drive shafts, and drive axles.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	2	2	60

**National Assessment:**

**Prerequisite:**                        Instructor Approved

**Student Learning Outcomes:**

1. Explore clutch diagnosis and repair.
  - a. Identify causes of clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action.
  - b. Inspect and adjust clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push and pull-type assemblies); check pedal height and travel; perform needed action.
  - c. Inspect, adjust, repair, or replace hydraulic clutch slave and master cylinders, lines, and hoses; bleed system.
  - d. Inspect, adjust, lubricate, or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals.
  - e. Inspect, adjust, and replace single-disc clutch pressure plate and clutch disc.
  - f. Inspect, adjust, and replace two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs.
  - g. Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer; perform needed action.
  - h. Inspect, adjust, and replace self-adjusting/continuous-adjusting clutch mechanisms.
  - i. Inspect and replace pilot bearing.
  - j. Inspect flywheel mounting area on crankshaft, rear main oil seal, and measure crankshaft end play; determine needed action.
  - k. Inspect flywheel, and starter ring gear; measure flywheel face and pilot bore runout; determine needed action.
  - l. Inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action.
  
2. Discuss and perform transmission diagnosis and repair.
  - a. Identify causes of transmission noise, shifting, lockup, jumping-out-of-gear, overheating, and vibration problems; determine needed action.
  - b. Inspect, test, repair, or replace air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies.
  - c. Inspect and replace transmission mounts, insulators, and mounting bolts.
  - d. Inspect for leakage and replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; repair as needed.
  - e. Check transmission fluid level and condition; determine needed service; add proper type of lubricant.
  - f. Inspect, adjust, and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires.
  - g. Remove and reinstall transmission.
  - h. Inspect input shaft, gear, spacers, bearings, retainers, and slingers; determine needed action.

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- i. Disassemble, inspect, and replace internal transmission components; such as, sliding clutches, bearings, shafts, as necessary to meet manufacturer's specifications.
  - j. Inspect transmission oil filters/coolers; replace as needed.
  - k. Inspect speedometer components; determine needed action.
  - l. Inspect and adjust power take-off (P.T.O.) assemblies, controls, and shafts; determine needed action.
  - m. Inspect and test function of reverse light, neutral start, and warning device circuits; determine needed action.
  - n. Inspect and test transmission temperature gauge and sensor/sending unit; determine needed action.
  - o. Inspect and test operation of automated mechanical transmission and manual electronic shift controls, shift, range and splitter solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses; determine needed action.
  - p. Inspect and test operation of automated mechanical transmission electronic shift selectors, air and electrical switches, displays and indicators, wiring harnesses, and air lines; determine needed action.
  - q. Use appropriate diagnostic tools and procedures to diagnose automated mechanical transmission problems; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed action.
  - r. Inspect and test operation of automatic transmission electronic shift controls, shift solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.
  - s. Inspect and test operation of automatic transmission electronic shift selectors, switches, displays and indicators, wiring harnesses.
  - t. Use appropriate diagnostic tools and procedures to diagnose automatic transmission problems; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed action.
3. Discuss and perform driveshaft and universal joint diagnosis and repair.
    - a. Identify causes of driveshaft and universal joint noise and vibration problems; determine needed action.
    - b. Inspect, service, or replace driveshaft, slip joints, yokes, drive flanges, and universal joints, driveshaft boots and seals, and retaining hardware; check phasing of all shafts.
    - c. Inspect driveshaft center support bearings and mounts; determine needed action.
    - d. Measure driveline angles; determine needed action.
  4. Discuss and perform drive axle diagnosis and repair. (DOK3, MDT6)
    - a. Identify causes of drive axle(s) drive unit noise and overheating problems; determine needed action.
    - b. Check and repair fluid leaks; inspect and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals.
    - c. Check drive axle fluid level and condition; determine needed service; add proper type of lubricant.
    - d. Remove and replace differential carrier assembly.
    - e. Inspect and replace differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearings.
    - f. Inspect and replace components of locking differential case assembly.
    - g. Inspect differential carrier housing and caps, side bearing bores, and pilot (spigot, pocket) bearing bore; determine needed action.
    - h. Measure ring gear runout; determine needed action.
    - i. Inspect and replace ring and drive pinion gears, spacers, sleeves, bearing cages, and bearings.
    - j. Measure and adjust drive pinion bearing preload.
    - k. Measure and adjust drive pinion depth.
    - l. Measure and adjust side bearing preload and ring gear backlash.
    - m. Check and interpret ring gear and pinion tooth contact pattern; determine needed action.
    - n. Inspect, adjust, or replace ring gear thrust block/screw.
    - o. Inspect power divider (inter-axle differential) assembly; determine needed action.
    - p. Inspect, adjust, repair, or replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls.

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- q. Inspect, repair, or replace drive axle lubrication system: pump, troughs, collectors, slingers, tubes, and filters.
- r. Inspect and replace drive axle shafts.
- s. Remove and replace wheel assembly; check rear wheel seal and axle flange gasket for leaks; perform needed action.
- t. Identify causes of drive axle wheel bearing noise and check for damage; perform needed action.
- u. Inspect and test drive axle temperature gauge and sending unit/sensor; determine needed action.
- v. Clean, inspect, lubricate and replace wheel bearings; replace seals and wear rings; inspect and replace retaining hardware; adjust drive axle wheel bearings.

## VALIDATION COPY

**Course Number and Name:**           **DET 1813            Air Conditioning and Heating Systems**

**Classification:**                       **Career Certificate Core Requirement**

**Description:**                         This is a course designed to provide skills and knowledge related to the operation, maintenance, and repair of air conditioning and heating systems used in commercial equipment, includes instruction in theories and operating principles, A/C system diagnosis and repair, clutch and compressor repair, evaporator and condenser repair, and heating system repair.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	1	4	75

**National Assessment:**

**Prerequisite:**                         **Instructor Approved**

**Student Learning Outcomes:**

All practices and procedures must be performed under the direct supervision of a teacher who has been certified to service air conditioning and refrigeration equipment. All practices and procedures must be performed according to current mandates, standards, and regulations.

Competencies 1 through 5 should be accomplished in accordance with published EPA and appropriate SAE “J” standards for R-12, R-134a, and EPA approved refrigerant blends.

1. Identify theories, operating principles, and current regulations related to air conditioner service.
  - a. Discuss and perform HVAC systems diagnosis, service, and repair.
    - 1) Verify the need for service or repair of HVAC systems based on unusual operating noises; determine needed action.
    - 2) Verify the need for service or repair of HVAC systems based on unusual visual, smell, and touch conditions; determine needed action.
    - 3) Identify system type and components (cycling clutch orifice tube – CCOT, expansion valve) and conduct performance test(s) on HVAC systems; determine needed action.
    - 4) Retrieve diagnostic codes; determine needed action.
  - b. Discuss and perform A/C system and component diagnosis, service, and repair.
    - 1) Identify causes of temperature control problems in the A/C system; determine needed action.
    - 2) Identify refrigerant and lubricant types; check for contamination; determine needed action.
    - 3) Diagnose A/C system problems indicated by pressure gauge and temperature readings; determine needed action.
    - 4) Identify A/C system problems indicated by visual, audible, smell, and touch procedures; determine needed action.
    - 5) Perform A/C system leak test; determine needed action.
    - 6) Recover, evacuate, and recharge A/C system using appropriate equipment.
    - 7) Identify contaminated A/C system components and hoses; determine needed action.
2. Explore A/C system and component diagnosis, service, and repair.
  - a. Discuss and perform compressor and clutch diagnosis, service, and repair.
    - 1) Identify A/C system problems that cause protection devices (pressure, thermal, and electronic) to interrupt system operation; determine needed action.
    - 2) Inspect, test, and replace A/C system pressure, thermal, and electronic protection devices.
    - 3) Inspect and replace A/C compressor drive belts, pulleys, and tensioners; adjust belt tension and check alignment.
    - 4) Inspect, test, service, or replace A/C compressor clutch components or assembly.

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- 5) Inspect and correct A/C compressor lubricant level (if applicable).
  - 6) Inspect, test, or replace A/C compressor.
  - 7) Inspect, repair, or replace A/C compressor mountings and hardware.
3. Explore A/C system and component diagnosis, service, and repair.
- a. Discuss and perform evaporator, condenser, and related components diagnosis, service, and repair.
    - 1) Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier, and hoses.
    - 2) Inspect A/C system hoses, lines, filters, fittings, and seals; determine needed action.
    - 3) Inspect A/C condenser for proper air flow.
    - 4) Inspect and test A/C system condenser and mountings; determine needed action.
    - 5) Inspect and replace receiver/drier or accumulator/drier.
    - 6) Inspect and test cab/sleeper refrigerant solenoid, expansion valve(s); check placement of thermal bulb (capillary tube); determine needed action.
    - 7) Remove and replace orifice tube.
    - 8) Inspect and test cab/sleeper evaporator core; determine needed action.
    - 9) Inspect, clean, or repair evaporator housing and water drain; inspect and service/replace evaporator air filter.
    - 10) Identify and inspect A/C system service ports (gauge connections); determine needed action.
    - 11) Identify the cause of system failures resulting in refrigerant loss from the A/C system high pressure relief device; determine needed action.
  - b. Discuss and perform heating and engine cooling systems diagnosis, service, and repair.
    - 1) Diagnose the cause of outlet air temperature control problems in the HVAC system; determine needed action.
    - 2) Identify window fogging problems; determine needed action.
    - 3) Perform engine cooling system tests for leaks, protection level, contamination, coolant level, coolant type, temperature, and conditioner concentration; determine needed action.
    - 4) Inspect engine cooling and heating system hoses, lines, and clamps; determine needed action.
    - 5) Inspect and test radiator, pressure cap, and coolant recovery system (surge tank); determine needed action.
    - 6) Inspect water pump for leaks and bearing play; determine needed action.
    - 7) Inspect and test thermostats, by-passes, housings, and seals; determine needed repairs.
    - 8) Recover, flush, and refill with recommended coolant/additive package; bleed cooling system.
    - 9) Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed. DOK
    - 10) Inspect and test heating system coolant control valve(s) and manual shut-off valves; determine needed action.
    - 11) Inspect and flush heater core; determine needed action.
4. Explore operating systems and related controls diagnosis and repair.
- a. Discuss and perform electrical diagnosis, service, and repair.
    - 1) Identify causes of HVAC electrical control system problems; determine needed action.
    - 2) Inspect and test HVAC blower motors, resistors, switches, relays, modules, wiring, and protection devices; determine needed action.
    - 3) Inspect and test A/C compressor clutch relays, modules, wiring, sensors, switches, diodes, and protection devices; determine needed action.
    - 4) Inspect and test A/C related electronic engine control systems; determine needed action.
    - 5) Inspect and test engine cooling/condenser fan motors, relays, modules, switches, sensors, wiring, and protection devices; determine needed action.
    - 6) Inspect and test electric actuator motors, relays/modules, switches, sensors, wiring, and protection devices; determine needed action.
    - 7) Inspect and test HVAC system electrical/electronic control panel assemblies; determine needed action.

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- b. Discuss and perform air/vacuum/mechanical diagnosis, service, and repair.
  - 1) Identify causes of HVAC air, and mechanical control problems; determine needed action.
  - 2) Inspect and test HVAC system air and mechanical control panel assemblies; determine needed action.
  - 3) Inspect, test, and adjust HVAC system air and mechanical control cables and linkages; determine needed action.
  - 4) Inspect and test HVAC system actuators and hoses; determine needed action.
  - 5) Inspect, test, and adjust HVAC system ducts, doors, and outlets; determine needed action.
- 5. Explore refrigerant recovery, recycling, and handling diagnosis, service, and repair. ,
  - a. Maintain and verify correct operation of certified equipment.
  - b. Identify and recover A/C system refrigerant.
  - c. Recycle or properly dispose of refrigerant.
  - d. Handle, label, and store refrigerant.
  - e. Test recycled refrigerant for non-condensable gases.
- 6. Complete the requirements for Section 609 Certification.

### AED Standards

Demonstrate knowledge of the following:

#### 6. Air Conditioning/Heating

##### 6.1 Fundamental knowledge

- a. Demonstrate knowledge of heat sources, types of heat transfer, and how humidity affects heat transfer. Emphasis will be placed on factors that affect heat transfer and how to measure heat energy.
- b. Demonstrate knowledge of the following terms:
  - 1) Sensible heat
  - 2) Change of state
  - 3) Saturation temperature
  - 4) Latent heat (Hidden heat)
  - 5) Latent heat of fusion
  - 6) Latent heat of evaporation
  - 7) Latent heat of condensation
  - 8) Super heated
  - 9) Sub-cooled
  - 10) Vapor
  - 11) Gas
- c. Demonstrate the knowledge to measure and calculate the effects of pressures on liquids. Emphasis will be placed on understanding and using pressure and temperature (P/T) charts.
- d. Demonstrate knowledge of refrigerant characteristics in relation to environmental damage. Emphasis will be placed on identification, labeling, and handling of refrigerants in accordance with EPA regulations.
- e. Demonstrate knowledge of the types of oils used in AC systems.
- f. Demonstrate knowledge on handling and storing of refrigerant oils.
- g. Demonstrate knowledge on recovery, recycle, and reclaiming of refrigerants with respect to the amounts of oil, water and particulates that are removed.

##### 6.2 AC systems operation

- a. Demonstrate knowledge of the following system components:
  - 1) Compressor
  - 2) Condenser
  - 3) Metering device
  - 4) Evaporator
  - 5) Service valves
  - 6) Schrader valves
  - 7) Receiver-drier

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- 8) Accumulator
  - 9) Lines
  - b. Demonstrate knowledge of refrigerant flow through an AC system.
  - c. Demonstrate the knowledge of the state (super heated vapor, saturated mixture, and sub-cooled liquid) of the refrigerant at various points in an AC system. Emphasis will be placed on the locations in the system that the refrigerant exists as a saturated mixture.
- 6.3 Servicing AC systems
- a. Demonstrate knowledge of how to identify various types and refrigerant capacities of AC systems. Emphasis will be placed on the ability to identify types and capacities by using manufacturers' service publications along with equipment tags, labels, and specifications.
  - b. Demonstrate the ability to properly connect and disconnect gauge manifold sets. Emphasis will be placed on using proper procedures to purge hoses to prevent cross-contamination and introduction of non-condensables.
  - c. Demonstrate the ability to connect gauge sets to systems having either Schrader or Stem type service valves.
  - d. Demonstrate the ability to properly evacuate and dehydrate an AC system.
  - e. Demonstrate knowledge of the damage caused to AC systems by non-condensables and moisture. Emphasis will be placed on having knowledge of using micron gauges and establishing minimum and maximum evacuation time periods to completely dehydrate AC systems.
  - f. Demonstrate the ability to properly recover and charge AC systems with refrigerants.
  - g. Emphasis placed on properly connecting and operating gauge manifold sets, recovery and charging equipment.
  - h. Demonstrate the knowledge and ability to describe the conditions that need to exist to charge AC systems with refrigerant existing as a liquid or vapor into the high or low side.
  - i. Demonstrate the ability to add oil, dye, and refrigerants to operating AC systems.
- 6.4 Testing, troubleshooting, diagnosing and repairing AC systems
- a. Demonstrate the ability to perform a visual inspection of an AC system.
    - 1) Loose or missing service caps.
    - 2) Oily spots – connections – evaporator drain tube.
    - 3) Belt tension
    - 4) Condensor condition
    - 5) Determine refrigerant type.
  - b. Demonstrate the ability to visually identify the type of AC system and determine the amount of refrigerant charge.
    - 1) TXV(H-Block) – Receiver/drier
    - 2) Metered orifice - accumulator
  - c. Demonstrate the ability to identify control systems and components.
  - d. Demonstrate the ability to troubleshoot and diagnose AC systems by converting system pressures to saturated mixture temperatures and comparing this to temperature readings taken at key points in the system.
  - e. Demonstrate the ability to troubleshoot and diagnose metering devices and limit switch malfunctions.
  - f. Demonstrate the ability to detect refrigerant leaks.
  - g. Demonstrate the knowledge and/or ability to replace or repair AC system components i.e. compressor, compressor clutch, seals, metering valves, condenser, receiver-drier, accumulator, limit switches and lines.
  - h. Demonstrate the ability to test the cooling capabilities of an AC system including controls. Emphasis will be placed on demonstrating the knowledge to determine the operational conditions needed to validate a performance test.
  - i. Demonstrate technical write-up competency
    - Demonstrate logic and critical thinking in identifying, evaluating and diagnosing customer complaint.
    - Identify the root cause of failure

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- Correction procedure
- Machine inspection

### 6.5 Heating system operation

- a. Demonstrate knowledge of the following system components:
  - 1) Water pump
  - 2) Heater core
  - 3) Coolant control valve
  - 4) Coolant lines
  - 5) Engine thermostat
- b. Demonstrate knowledge of how water pumps work.
- c. Demonstrate knowledge of coolant flow direction.
- d. Demonstrate knowledge of the function of thermostats.

### 6.6 Servicing heating systems

- a. Demonstrate knowledge of how to correctly remove and install heater core and coolant lines.
- b. Demonstrate knowledge of how to correctly remove and install heater system control valves.
- c. Demonstrate knowledge of how to correctly remove, test and install engine thermostats.

### 6.7 Pressurized cabs

- a. Demonstrate knowledge of the purpose and function of pressurized cab systems.
- b. Demonstrate knowledge of how to correctly remove, clean, and install cab air filters.

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**Course Number and Name:**        **DET 2623        Advanced Brake Systems (Air)**

**Classification:**                      Career Certificate Core Requirement

**Description:**                        A basic course to provide students with instruction and practice in the maintenance and repair of air brake systems commonly used on commercial diesel powered transportation and heavy equipment, includes instruction in maintenance and repair of the air supply system, mechanical system, antilock braking system, and traction control system.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	2	2	60

**National Assessment:**              None

**Prerequisite:**                         Instructor Approved

**Student Learning Outcomes:**

1. Explore air brakes diagnosis and repair.
  - a. Read, analyze and interpret air system diagrams.
  - a. Identify poor stopping, air leaks, premature wear, pulling, grabbing, dragging, or balance problems caused by supply and service system malfunctions; determine needed action.
  - b. Check air system build-up time; determine needed action.
  - c. Drain air reservoir/tanks; check for oil, water, and foreign material; determine needed action.
  - d. Inspect compressor drive gear and coupling; replace as needed.
  - e. Inspect air compressor inlet; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed.
  - f. Inspect and test system pressure controls: governor, unloader assembly valves, filters, lines, hoses, and fittings; adjust or replace as needed.
  - g. Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed.
  - h. Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check-valves, manual and automatic drain valves; replace as needed.
  - i. Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed.
  - j. Inspect and test brake application (foot) valve, fittings, and mounts; check pedal operation; replace as needed.
  - k. Inspect and test stop light circuit switches, wiring, and connectors; repair or replace as needed.
  - l. Inspect and test hand brake (trailer) control valve, lines, fittings, and mountings; repair or replace as needed.
  - m. Inspect and test brake relay valves; replace as needed.
  - n. Inspect and test quick release valves; replace as needed.
  - o. Inspect and test tractor protection valve; replace as needed.
  - p. Inspect and test emergency (spring) brake control/modulator valve(s); replace as needed.
  - q. Inspect and test low pressure warning devices, wiring, and connectors; repair or replace as needed.
  - r. Inspect and test air pressure gauges, lines, and fittings; replace as needed.
  
2. Discuss and perform mechanical/foundation diagnosis and repair.
  - a. Identify 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.
  - b. Inspect and test service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; repair or replace as needed.
  - c. Inspect and service slack adjusters; perform needed action.
  - d. Inspect camshafts, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; replace as needed.

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- e. Inspect, clean, and adjust air disc brake caliper assemblies; determine needed repairs.
  - f. Inspect and measure brake shoes or pads; perform needed action.
  - g. Inspect and measure brake drums or rotors; perform needed action.
3. Discuss and perform parking brakes diagnosis and repair.
- a. Inspect and test parking (spring) brake chamber diaphragm and seals; replace parking (spring) brake chamber; dispose of removed chambers in accordance with local regulations.
  - b. Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed.
  - c. Inspect and test parking (spring) brake application and release valve; replace as needed.
  - d. Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations.
  - e. Inspect and test low pressure warning devices, wiring, and connectors; replace as needed.
  - f. Inspect and test air pressure gauges, lines, and fittings; replace as needed.
  - g. Inspect drive line parking brake drums, rotors, bands, shoes, mounting hardware, and adjusters; adjust, repair, or replace as needed.
  - b. Inspect drive line parking brake application system pedal, cables, linkage, levers, pivots, and springs; adjust, repair, or replace as needed.
  - c. Check operation of parking (spring) brake chamber; determine needed repairs.
  - d. Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed.
  - e. Inspect and test parking (spring) brake application and release valve; replace as needed.
  - f. Manually release and rest parking (spring) brakes in accordance with manufacturer's recommendations.
4. Discuss and perform mechanical foundation system diagnosis and repair.
- a. Diagnose problems caused by foundation brake, slack adjuster, and brake chamber problems; determine needed repairs.
  - b. Inspect, test, adjust, and service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; repair or replace as needed.
  - c. Inspect and service manual and automatic slack adjusters; adjust or replace as needed.
  - d. Inspect cams, rollers, shafts, bushings, seals, spacers, and retainers; service or replace as needed.
  - e. Inspect brake spider, shields, anchor pins, bushings, and springs; service or replace as needed.
  - f. Inspect wedge brake spider, manual and automatic adjuster plungers, housing, and wedge assembly; repair or replace as needed.
  - g. Inspect, clean, and adjust air disc brake caliper assemblies; determine needed repairs.
  - h. Inspect brake shoes or pads; replace as needed.
  - i. Inspect and measure brake drums or rotors; determine needed repairs.
6. Discuss and perform antilock brake system (ABS) diagnosis and repair.
- a. Inspect, test, and service ABS air, electrical/electronic, and mechanical components.
  - b. Diagnose poor stopping, wheel lock-up, pulsation, and noise problems caused by the ABS; determine needed repairs.
  - c. Observe ABS warning light at startup; determine if further diagnosis is needed.
  - d. Diagnose ABS electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine needed repairs.
  - e. Service, test, and adjust ABS speed sensors following manufacturer's recommended procedures.
  - f. Discuss the operation of the traction control system as related to ABS and engine controls.

### ASE Student Certification Standards

#### Brakes

##### A. Air Brakes

###### 1. Air Supply and Service Systems

1. Identify poor stopping, air leaks, premature wear, pulling, grabbing, dragging, or balance problems caused by supply and service system malfunctions; determine needed action.

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2. Check air system build-up time; determine needed action.
3. Drain air reservoir/tanks; check for oil, water, and foreign material; determine needed action.
4. Inspect compressor drive gear and coupling; replace as needed.
5. Inspect air compressor inlet; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed.
6. Inspect and test air system pressure controls: governor, unloader assembly valves, filters, lines, hoses, and fittings; adjust or replace as needed.
7. Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed.
8. 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.
9. Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed.
10. Inspect and test brake application (foot) valve, fittings, and mounts; check pedal operation; replace as needed.
11. Inspect and test stop light circuit switches, wiring, and connectors; repair or replace as needed.
12. Inspect and test hand brake (trailer) control valve, lines, fittings, and mountings; repair or replace as needed.
13. Inspect and test brake relay valves; replace as needed.
14. Inspect and test quick release valves; replace as needed.
15. Inspect and test tractor protection valve; replace as needed.
16. Inspect and test emergency (spring) brake control/modulator valve(s); replace as needed.
17. Inspect and test low pressure warning devices, wiring, and connectors; repair or replace as needed.
18. Inspect and test air pressure gauges, lines, and fittings; replace as needed.

### 2. *Mechanical/Foundation*

1. Identify 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.
2. Inspect and test service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; repair or replace as needed.
3. Inspect and service slack adjusters; perform needed action.
4. Inspect camshafts, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; replace as needed.
5. Inspect, clean, and adjust air disc brake caliper assemblies; determine needed repairs.
6. Inspect and measure brake shoes or pads; perform needed action.
7. Inspect and measure brake drums or rotors; perform needed action.

### 3. *Parking Brakes*

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.
2. Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed.
3. Inspect and test parking (spring) brake application and release valve; replace as needed.
4. Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations.

### C. Air and Hydraulic Antilock Brake Systems (ABS) and Automatic Traction Control (ATC)

1. Observe antilock brake system (ABS) warning light operation (includes dash mounted trailer ABS warning light); determine needed action.
2. Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action.
3. Identify poor stopping and wheel lock-up problems caused by failure of the antilock brake system (ABS); determine needed action.
4. Test and check operation of antilock brake system (ABS) air, hydraulic, electrical, and mechanical components; perform needed action.
5. Test antilock brake system (ABS) wheel speed sensors and circuits; adjust or replace as needed.
6. Bleed the ABS hydraulic circuits following manufacturers' procedures.

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7. Observe automatic traction control (ATC) warning light operation; determine needed action.
8. Diagnose automatic traction control (ATC) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action.

### D. Wheel Bearings

1. Clean, inspect, lubricate and replace wheel bearings and races/cups; replace seals and wear rings; inspect spindle/tube; inspect and replace retaining hardware; adjust wheel bearings.
2. Inspect or replace extended service wheel bearing assemblies.

# TECHNICAL CERTIFICATE REQUIRED COURSES

**Course Number and Name:**        **DET 2253        Steering and Suspension Systems**

**Classification:**                                Technical Certificate Core Requirement

**Description:**                                This is a course designed to provide advanced skills and knowledge related to the operation, maintenance, and repair of heavy duty steering and suspension systems, Includes instruction in steering column and steering gear, power steering unit, steering linkage, suspension, wheel alignment, and related components diagnosis and repair..

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	2	2	60

**National Assessment:**

**Prerequisite:**                                Instructor Approved

**Student Learning Outcomes:**

1. Explore steering systems.
  - a. Discuss and perform steering column diagnosis and repair.
    - 1) Identify causes of fixed and driver adjustable steering column and shaft noise, looseness, and binding problems; determine needed action.
    - 2) Inspect and service steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft.
    - 3) Check and adjust cab mounting and ride height.
    - 4) Center the steering wheel as needed.
    - 5) Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' procedures.
  - b. Discuss and perform steering unit diagnosis and repair.
    - 1) Identify causes of power steering system noise, steering binding, darting/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.
    - 2) Determine recommended type of power steering fluid; check level and condition; determine needed action.
    - 3) Flush and refill power steering system; purge air from system.
    - 4) Perform power steering system pressure, temperature, and flow tests; determine needed action.
    - 5) Inspect, service, or replace power steering reservoir including filter, seals, and gaskets.
    - 6) Inspect power steering pump drive gear and coupling; replace as needed.
    - 7) Inspect, adjust, or replace power steering pump, mountings, and brackets.
    - 8) Inspect and replace power steering system cooler, lines, hoses, clamps/mountings, hose routings, and fittings.
    - 9) Inspect, adjust, repair, or replace integral type power steering gear(s) (single and/or dual) and mountings.
  - c. Discuss and perform steering linkage diagnosis and repair.
    - 1) Inspect and align pitman arm; replace as needed.
    - 2) Check and adjust steering (wheel) stops.
    - 3) Inspect and lubricate steering arms and linkages.
2. Discuss and perform suspension systems diagnosis and repair.
  - a. Inspect front axles and attaching hardware; determine needed action.

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- b. Inspect and service kingpin, steering knuckle bushings, locks, bearings, seals, and covers; determine needed action.
  - c. Inspect shock absorbers, bushings, brackets, and mounts; replace as needed.
  - d. Inspect leaf springs, center bolts, clips, pins and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed action.
  - e. Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, torque arms, related bushings, mounts, shims, and cams; determine needed action.
  - f. Inspect tandem suspension equalizer components; determine needed action.
  - g. Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; adjust, repair or replace as needed.
  - h. Inspect air springs, mounting plates, springs, suspension arms, and bushings; replace as needed.
  - i. Measure ride height; determine needed action.
  - j. Identify rough ride problems; determine needed action.
3. Discuss and perform wheel alignment diagnosis, adjustment, and repair.
    - a. Identify causes of vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problems; adjust or repair as needed.
    - b. Check camber; determine needed action.
    - c. Check caster; adjust as needed.
    - d. Check toe; adjust as needed.
    - e. Check rear axle(s) alignment (thrust line/centerline) and tracking; adjust or repair as needed.
    - f. Identify turning/Ackerman angle (toe-out-on-turns) problems; determine needed action.
    - g. Check front axle alignment (centerline); adjust or repair as needed.
  4. Discuss and perform wheels and tires diagnosis and repair.
    - a. Identify tire wear patterns; check tread depth and pressure; determine needed action.
    - b. Identify wheel/tire vibration, shimmy, pounding, hop (tramp) problems; determine needed action.
    - c. Remove and install steering and drive axle wheel/tire assemblies.
    - d. Inspect tire for proper application, (size, load range, position, and tread design); determine needed action.
    - e. Inspect wheel/rims for proper application, load range, size, and design; determine needed action.
    - f. Check operation of tire pressure monitoring system; determine needed action.
  5. Discuss and perform frame service and repair.
    - a. Inspect, service, and/or adjust fifth wheel, pivot pins, bushings, locking mechanisms, and mounting hardware.
    - b. Inspect and service sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.
    - c. Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage; determine needed repairs.
    - d. Inspect, install, or repair frame hangers, brackets, and cross members in accordance with manufacturers' recommended procedures.
    - e. Inspect, repair, or replace pintle hooks and draw bars.

### ASE Student Certification Standards

#### Suspension and Steering

##### A. Steering Systems

###### 1. Steering Column

1. Identify causes of fixed and driver adjustable steering column and shaft noise, looseness, and binding problems; determine needed action.
2. Inspect and service steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft..
3. Check and adjust cab mounting and ride height.
4. Center the steering wheel as needed.
5. Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' procedures.

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### 2. *Steering Units*

1. Identify causes of power steering system noise, steering binding, darting/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.
2. Determine recommended type of power steering fluid; check level and condition; determine needed action.
3. Flush and refill power steering system; purge air from system.
4. Perform power steering system pressure, temperature, and flow tests; determine needed action.
5. Inspect, service, or replace power steering reservoir including filter, seals, and gaskets.
6. Inspect power steering pump drive gear and coupling; replace as needed.
7. Inspect, adjust, or replace power steering pump, mountings, and brackets.
8. Inspect and replace power steering system cooler, lines, hoses, clamps/mountings, hose routings, and fittings.
9. Inspect, adjust, repair, or replace integral type power steering gear(s) (single and/or dual) and mountings.

### 3. *Steering Linkage*

1. Inspect and align pitman arm; replace as needed.
2. Check and adjust steering (wheel) stops.
3. Inspect and lubricate steering arms and linkages.

## B. Suspension Systems

1. Inspect front axles and attaching hardware; determine needed action.
2. Inspect and service kingpin, steering knuckle bushings, locks, bearings, seals, and covers; determine needed action.
3. Inspect shock absorbers, bushings, brackets, and mounts; replace as needed.
4. Inspect leaf springs, center bolts, clips, pins and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed action.
5. Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, torque arms, related bushings, mounts, shims, and cams; determine needed action.
6. Inspect tandem suspension equalizer components; determine needed action.
7. Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; adjust, repair or replace as needed.
8. Inspect air springs, mounting plates, springs, suspension arms, and bushings; replace as needed.
9. Measure ride height; determine needed action.
10. Identify rough ride problems; determine needed action.

## C. Wheel Alignment Diagnosis, Adjustment, and Repair

1. Identify causes of vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problems; adjust or repair as needed.
2. Check camber; determine needed action.
3. Check caster; adjust as needed.
4. Check toe; adjust as needed.
5. Check rear axle(s) alignment (thrustline/centerline) and tracking; adjust or repair as needed.
6. Identify turning/Ackerman angle (toe-out-on-turns) problems; determine needed action.
7. Check front axle alignment (centerline); adjust or repair as needed.

## D. Wheels and Tires

1. Identify tire wear patterns, check tread depth and pressure determine needed action.
2. Identify wheel/tire vibration, shimmy, pounding, hop (tramp) problems; determine needed action.
3. Remove and install steering and drive axle wheel/tire assemblies.
4. Inspect tire for proper application, (size, load range, position, and tread design); determine needed action.
5. Inspect wheel/rims for proper application, load range, size, and design; determine needed action.
6. Check operation of tire pressure monitoring system; determine needed action.

## E. Frame and Coupling Devices

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1. Inspect, service, and/or adjust fifth wheel, pivot pins, bushings, locking mechanisms, and mounting hardware.
2. Inspect and service sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.
3. Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage; determine needed repairs.
4. Inspect, install, or repair frame hangers, brackets, and cross members in accordance with manufacturers' recommended procedures.
5. Inspect, repair, or replace pintle hooks and draw bars.

**VALIDATION COPY**

**Course Number and Name:**        **DET 2273**        **Electrical/Electronic Systems III**

**Classification:**                      Technical Certificate Core Requirement

**Description:**                        This course is designed to provide advanced skills and knowledge associated with the diagnosis, service, and repair of electrical and electronic systems on diesel engines, includes instruction in electronic fuel management systems.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	1	4	75

**National Assessment:**

**Prerequisite:**                        Instructor Approved

**Student Learning Outcomes:**

1. Explore, discuss, and repair electronic fuel management systems.
  - b. Interface with vehicle’s on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determine needed action.
  - c. Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; clear codes; determine further diagnosis.
  - d. Locate and use relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams).
  - e. Inspect and replace electrical connector terminals, seals, and locks.
  - f. Inspect and test switches, sensors, controls, actuator components, and circuits; adjust or replace as needed.
  - g. Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), access and interpret customer programmable parameters.
  - h. Inspect, test, and adjust electronic unit injectors (EUI); determine needed action.
  - i. Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable).
  - j. Perform cylinder contribution test utilizing recommended electronic diagnostic tool.
  - k. Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action.
  - l. Perform on-engine inspections and tests on hydraulic electronic unit injector high pressure oil supply and control systems; determine needed action.
  - m. Perform on-engine inspections and tests on common rail type injection systems; determine needed action.
  - n. Inspect high pressure injection lines, hold downs, fittings and seals; determine needed action.

**AED Standards**

Demonstrate knowledge of the following:

2. Electronics/Electrical Systems
  - 2.6 Electrical schematics/diagrams
    - a. Demonstrate the ability to identify basic electrical/electronic symbols.
    - b. Demonstrate the ability to trace various cir-cuits using wiring schematics/diagrams.
    - c. Demonstrate a working knowledge of diagnosing and troubleshooting electrical systems using schematics/diagrams.
  - 2.7 SAE computer Can-Buss standards
    - a. Demonstrate the knowledge of the different systems used to communicate on computer controlled machinery. SAE J1587 & J1939.
    - b. Understanding the importance of twisted and shielded wire systems.

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- c. Demonstrate the knowledge of the codes to identify errors within the different systems.
- 2.8 Diagnostics
- a. Understand the complaint prior to beginning diagnostic tests.
  - b. Demonstrate the ability to perform a diagnostic procedure.
  - c. Demonstrate the ability to reason with regard to a specific malfunction in the system.
  - d. Demonstrate mastering the use of all test equipment including digital volt ohm meter (D.V.O.M.), lap top computers, and other system specific troubleshooting devices.
  - e. Demonstrate the ability to use schematic diagrams and follow troubleshooting flow charts in selected technical manuals.
  - f. Utilize an interactive equipment diagnostic program.
  - g. Demonstrate technical write-up competency
    - Demonstrate logic and critical thinking in identifying, evaluating and diagnosing customer complaint.
    - Identify the root cause of failure
    - Correction procedure
    - Machine inspection

### ASE Student Certification Standards

#### *Electrical/Electronic Systems*

##### G. Related Electrical Systems

1. 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.
2. Identify causes of constant, intermittent, or no horn operation; determine needed action.
3. Inspect and test horn circuit relays, horns, switches, connectors, wires, and control components/modules; repair or replace as needed.
4. Identify causes of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems; determine needed action.
5. Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, wires and control components/modules; repair or replace as needed.
6. Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed.
7. Inspect and test windshield washer motor or pump/relay assembly, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed.
8. Inspect and test side view mirror motors, heater circuit grids, relays, switches, connectors, terminals, wires and control components/modules; repair or replace as needed.
9. Inspect and test heater and A/C electrical components including: A/C clutches, motors, resistors, relays, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed.
10. Inspect and test auxiliary power outlet, integral fuse, connectors, terminals, wires, and control components/modules; repair or replace as needed.
11. Identify causes of slow, intermittent, or no power side window operation; determine needed action.
12. Inspect and test motors, switches, relays, connectors, terminals, wires, and control components/modules of power side window circuits; repair or replace as needed.
13. Inspect and test block heaters; determine needed repairs.
14. Inspect and test cruise control electrical components; repair or replace as needed.
15. Inspect and test switches, relays, controllers, actuator/solenoids, connectors, terminals, and wires of electric door lock circuits.
16. Check operation of keyless and remote lock/unlock devices; determine needed action.
17. Inspect and test engine cooling fan electrical control components/modules; repair or replace as needed.
18. Identify causes of data bus communication problems; determine needed action.

**VALIDATION COPY**

**Course Number and Name:**            **DET 2383            Diesel Systems III—Compare to Preventive Maintenance & DS II**

**Classification:**                            Technical Elective

**Description:**                              A basic course to provide students with an opportunity to diagnosis, service, and repair of general engine operations and fuel system operations.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	2	2	60

**National Assessment:**                None

**Prerequisite:**                              Instructor Approved

**Student Learning Outcomes:**

1. Explore and perform general engine diagnosis.
  - a. Inspect fuel, oil, and coolant levels, and condition; determine needed action.
  - b. Identify causes of engine fuel, oil, coolant, air, and other leaks; determine needed action.
  - c. Listen for engine noises; determine needed action.
  - d. Observe engine exhaust smoke color and quantity; determine needed action.
  - e. Identify causes of no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action.
  - f. Identify causes of surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action.
  - g. Identify engine vibration problems; determine needed action.
  - h. Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; verify customer programmable parameters; clear codes; determine further diagnosis.
  
2. Explore fuel systems.
  - a. Discuss and perform fuel supply system diagnosis and repair.
    - 1) Check fuel level and condition; determine needed action.
    - 2) Perform fuel supply and return system tests; determine needed action.
    - 3) Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determine needed action.
    - 4) Inspect, clean, and test fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates, and mounting hardware; determine needed action.
    - 5) Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determine needed action.
    - 6) Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump.

**AED Standards**

Demonstrate knowledge of the following:

5. Diesel Engines

5.7 Fuel and governing systems, mechanical and electronic systems

- a. Perform basic maintenance and diagnosis of the different fuel delivery systems available today. Demonstrate a basic understanding of the adjustment and repair of various governing systems used by the major manufacturers.
- b. Understand basic hydraulic principles and fluid transfer technology.
- c. Measure specific gravity of fuel and determine proper grade and/or contamination.
- d. Understand the use of fuel conditioners, fuel coolers and heaters. Recognize waste oil/fuel blends.

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- e. Measure fuel pressure/volume with correct diagnostic tools and compare to specifications.
- f. Determine and understand the problems with the basic supply systems. Understand the affects of air, moisture and contamination on the basic fuel system.

### 5.8 Diagnostics

- a. Understand tasks associated with troubleshooting emission controls and basic adjustments. Visual basic exhaust analysis; white, gray or black; as applicable.
- b. Discuss practical exercises in identification of common diesel engine problems using proper diagnostic tools and procedures.

## ASE Student Certification Standards

### *Diesel Engines*

#### G. Fuel Systems

##### 2. *Electronic Fuel Management System*

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.
2. Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determine needed action.
3. Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; clear codes; determine further diagnosis.
4. Locate and use relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams).
5. Inspect and replace electrical connector terminals, seals, and locks.
6. Inspect and test switches, sensors, controls, actuator components, and circuits; adjust or replace as needed.
7. Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), access and interpret customer programmable parameters.
8. Inspect, test, and adjust electronic unit injectors (EUI); determine needed action.
9. Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable).
10. Perform cylinder contribution test utilizing recommended electronic diagnostic tool.
11. Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action.
12. Perform on-engine inspections and tests on hydraulic electronic unit injector high pressure oil supply and control systems; determine needed action.
13. Perform on-engine inspections and tests on common rail type injection systems; determine needed action.
14. Inspect high pressure injection lines, hold downs, fittings and seals; determine needed action.

**VALIDATION COPY**

**Course Number and Name:**        **DET 2513        Hydraulic/Hydrostats II**

**Classification:**                                Technical Certificate Core Requirement

**Description:**                                    This is a course designed to provide diagnosis and repair of hydraulic brake systems, includes instruction in hydraulic and mechanical systems, power assist units, and antilock braking systems.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	2	2	60

**National Assessment:**

**Prerequisite:**                                    Instructor Approved

**Student Learning Outcomes:**

1. Understand hydrostatic theory.
2. Discuss pump identification and operation.
  - a. Gear
  - b. Vain
  - c. Piston fixed displacement
  - d. Piston variable displacement
3. Understand motor identification and operation.
4. Understand the function and operation of hydraulic valves.
  - a. System relief
  - b. Circuit relief
  - c. Anti-cavitation
  - d. Lift check
5. Discuss the function and operation of control valves.
6. Discuss cylinder identification and operation.
7. Understand accumulator identification and operation.
8. Identify fluid transfer components and filtering.
9. Demonstrate how to use the following test equipment:
  - a. Analog gauge
  - b. Digital gauge
  - c. Differential pressure gauge
  - d. Hydraulic flow meter
10. Understand the load sinceing systems and operation.
11. Discuss maintenance procedures.
12. Understand component repair and replacement.
13. Understand how to read hydraulic schematics.

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- a. Identify symbols
  - b. Follow oil path through valves
  - c. Identify if can open center or closed loop system
14. Discuss the following diagnostics:
- a. Check for hop spots.
  - b. Listen for high pressure leaks.
  - c. Test pump and motor for internal leakage and low charge pressure
  - d. Understand null adjustments.

### AED Standards

Demonstrate knowledge of the following:

- 3.1 Theory and operation, hydraulic and hydrostatic
- a. Demonstrate knowledge that fluids have no shape of their own, are practically incompressible, apply equal pressure in all directions, and provide great increases in work force.
  - b. Demonstrate the understanding of the function of a reservoir, pump, filters, relief valve, control valve, and cylinder in relation to each other.
  - c. Know that open and closed center systems are determined by one or all of the following: a) the type of control valve, b) the type of pump, c) use of unloading valve, d) path of oil return to reservoir from pump.
  - d. Describe a basic, but complete, open center hydraulic system, explaining the operation of the system, the route of fluid during the use of a function, and the route of the fluid while the machine is running when no hydraulic function is being used.
  - e. Describe a basic, but complete, closed center load sensing hydraulic system, explaining the operation of the system, the route of fluid during the use of a function, and the route of the fluid while the machine is running when no hydraulic function is being used.
  - f. Be able to identify applications, and the benefits of those applications on construction equipment.
  - g. Demonstrate knowledge of hydrostatic systems, including closed-loop and open-loop systems.
  - h. Understand the various types of cooling circuits.
  - i. Understand the purpose of a charge circuit and how charge pressure relates to hydrostatic system efficiency.
  - j. Explain the differences between hydraulic and hydrostatic systems.
  - k. Be able to identify applications, and the benefits of those applications on construction equipment.
  - l. Explain the different characteristics between various types of pumps, exhibit the ability to follow the oil flow through each pump both while using a hydraulic function and with no hydraulic function being used.
- 3.1a Pump identification and operation
- m. Be able to identify a gear pump, name all parts, follow the oil flow through a gear pump, identify inlet and outlet ports, and identify the direction of rotation of the pump.
  - n. Be able to identify a vane pump, name all parts of a vane pump, follow the oil flow through a vane pump, identify inlet and outlet ports of a vane pump, and identify the direction of rotation of the pump. Explain how a vane pump can be changed to operate in the opposite direction, when applicable.
  - o. Be able to identify various piston pumps, name all parts of a piston pump, follow the oil flow through a piston pump, identify inlet and outlet ports of a piston pump (both variable and fixed), and identify the direction of rotation of the pump.
  - p. Identify types of swash plate control (manual, servo piston, electronic, etc.).
- 3.1b Motor identification and operation
- a. Explain the different characteristics between the various motors; exhibit the ability to follow the oil flow through each motor while using a hydraulic function.
  - b. Identify a gear motor, name all parts of a gear motor, follow the oil flow through a gear motor, identify inlet and outlet ports of a gear motor, and identify the direction of rotation of the motor.
  - c. Identify a vane motor, name all parts of a vane motor, follow the oil flow through a vane motor, identify inlet and outlet ports of a vane motor, and identify the direction of rotation of the motor.
  - d. Identify radial and axial piston motors, name all parts of these piston motors, follow the oil flow through these piston motors, identify inlet and outlet ports of these piston motors (both variable and fixed), and identify the direction of rotation of the motors.

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- e. Identify a gerotor motor, name all parts, and understand its operation.

### 3.1c Function and operation of hydraulic valves

- a. Exhibit the differences between these three major types:

- 1) Pressure control valves
- 2) Directional control valves
- 3) Volume control valves

- b. Exhibit knowledge of the uses and functions of the following valves:

- 1) Direct acting relief valves
- 2) Pilot operated relief valves
- 3) Cartridge relief valves
- 4) Pilot operated valves
- 5) Sequence valves
- 6) Unloading valves
- 7) Multi-function valves
- 8) Counterbalance valves
- 9) Pressure reducing valves
- 10) Pressure limiting valves

### 3.1d Electro-hydraulics

- a. Exhibit knowledge of the uses and functions of the following valves:

- 1) Check valves
- 2) Rotary valves
- 3) Spool valves
- 4) Pilot controlled poppet valves
- 5) Electro-hydraulic valves
- 6) Electro-hydraulic control systems
- 7) Pulsewidth modulated valves

- b. Exhibit knowledge of the uses and functions of the following valves:

- 1) Flow control valves
  - a) Compensated
  - b) Non-compensated
- 2) Flow divider valves
  - a) Priority
  - b) Non-priority
  - c) Proportional

### c. Cylinder identification and operation

- a. Explain the uses and movements of the two types of cylinders.
- b. Be able to identify a single acting cylinder, name all of its parts, and follow the oil flow through the cylinder.
- c. Understand operation of a cushioned cylinder.

### 3.1e. Accumulator identification and operation

- a. Be able to identify a double acting cylinder, name all of its parts, and follow the oil flow through the cylinder.
- b. Explain how accumulators store energy, absorb shocks, build pressure, and maintain a constant pressure within a system.
- c. Explain where and why gas, pneumatic, spring loaded, and weighted accumulators are used.
- d. Explain and practice all accumulator safety practices.

## VALIDATION COPY

**Course Number and Name:**            **DET 2523            Heavy Equipment Power Trains**

**Classification:**                            Technical Certificate Core Requirement

**Description:**                              A basic course to provide students with maintenance and repair of fluid power and hydrostat transmissions used on heavy equipment to include operation and diagnosis and repair of system components.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	1	4	75

**National Assessment:**                None

**Prerequisite:**                             Instructor Approved

**Student Learning Outcomes:**

1. Describe general principles of operation as applied to fluid power transmissions.
  - a. Describe the general principles of operation as applied to fluid power transmissions.
  - b. Identify the major components of a fluid power transmission and describe their functions.
2. Perform diagnosis and repair on torque converters.
  - a. Perform on-vehicle service for a torque converter.
  - b. Dismount, disassemble, inspect, and repair torque converters.
3. Perform diagnosis, service, and repair on power-shift transmissions.
  - a. Perform on-vehicle service for a power-shift transmission.
  - b. Dismount, disassemble, inspect, and repair a power-shift transmission.
4. Perform diagnosis and repair on hydrostatic transmissions.
  - a. Perform on-vehicle service for a hydrostatic transmission.
  - b. Dismount, disassemble, inspect, and repair a hydrostatic transmission.

**AED Standards**

Demonstrate knowledge of the following:

4. Power Trains

4.1 Theory and operation

- a. Understand train components and how those components, as a whole, relate to one another. Demonstrate by following a power flow chart from flywheel to ground.
- b. Recognize hybrid systems and/or machines as they relate to safety concerns.
- c. Demonstrate knowledge by identifying the various types of gears using a matching test.
- d. Explain the benefit of one type of gear versus other types of gears using factors such as cost, strength, quietness, bulkiness, and capability of ratios.
- e. Identify types of bearings through matching tests.
- f. Demonstrate understanding of various types of bearings and proper adjustment procedures.
- g. Identify components of a torque converter and describe the relationship of those components to one another.
- h. Describe the operation of a given torque converter and various stages of operation.
- i. Use OEM manuals/service information to test a torque converter unit and determine if operation is within specifications.
- j. Exhibit your understanding of "sliding gear" transmissions by identifying components, explaining operation, and demonstrating power flow through all gear sets.

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- k. Identify shifting control components and explain their operation.
  - l. Demonstrate ability to perform adjustments to transmissions as instructed in the OEM service manual/information.
  - m. Identify all components in a single and multiple disc and plate-type clutch, including flywheel, pilot and release bearings, disc and pressure plate parts, and power train input shaft. Also, explain differences and benefits of solid and button-type clutches.
  - n. Explain operation of a selected clutch.
  - o. Demonstrate knowledge and operation of single and multiple-disc clutches by explaining the relationship of the clutch components to each other and their roles in the transfer of power.
  - p. Describe the relationship of the number of discs, types of discs (wet or dry), and type of clutch material to the transfer of torque and horsepower to the ground.
  - q. Demonstrate understanding of overrunning clutches by identifying the different types of clutches, their operation and various applications.
  - r. Explain the operation of magnetic clutches and name various applications.
  - s. Explain operation and applications.
  - t. Exhibit knowledge of electronic control systems by identifying components used on a specific unit.
  - u. Demonstrate understanding of a specific unit's operation by explaining the functions of all components and their relationships to one another.
  - v. Demonstrate ability to follow flow and troubleshooting charts to correctly identify the operation of a specific unit's system and troubleshooting methods used by the OEM.
  - w. Demonstrate understanding of theory and principals of hydrostatic systems by explaining, in writing, how a basic hydrostatic system functions.
  - x. Exhibit knowledge of hydrostatic transmission operation by explaining the flow of fluids through the charge circuit, pump, motor, control and loop circuits.
  - y. Explain the differences between fixed and variable pumps and motors, and the effects of their various combinations.
- 4.2 Driveshaft function and construction
- a. Demonstrate knowledge of driveshafts by recognizing components, realizing the effects of driveline angle and studying why driveline failures occur.
  - b. Exhibit understanding of basic differential operation by identifying the components and explaining how pinion, ring and bevel gears operate in relationship to each other.
  - c. Identify each type of differential locking device and explain in detail how each one operates.
  - d. Given a specific component and proper manuals/information, perform all adjustments on a differential with a new ring and pinion, and also perform all adjustments with original ring and pinion but with new bearings.
  - e. Identify the most common root causes of failure with differentials.
  - f. Exhibit knowledge of final drives by identifying the different types, and the components that make up final drives.
  - g. Perform adjustments according to OEM standards.
- 4.3 Fundamental theory of hydraulic and pneumatic braking systems
- a. Understand fundamental theory, adjustments and repair of hydraulic and pneumatic braking systems used primarily in mobile construction equipment.
  - b. Demonstrate knowledge of basic brake components, both wet internal and dry external.
  - c. Explain and sketch hydraulic and pneumatic brake systems, internal and external.

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- 4.4 Understanding maintenance practices in power trains
- a. Describe, in writing, procedures to follow in keeping a work area and the parts worked with clean.
  - b. Describe proper flushing procedures, including when components are replaced.
  - c. Describe scheduled oil sampling and cite several reasons why it is necessary.
- 4.5 Power train schematics and flow diagrams
- a. Be able to identify all electrical/hydraulic, pneumatic and mechanical symbols used in power train units.
  - b. Demonstrate ability to use schematics and flow diagrams to follow both control circuits and power flow of a given piece of equipment using the corresponding OEM manual/service information.
- 4.6 Troubleshooting and failure analysis
- a. Describe steps in solving a problem related to a power train system, decisions required to perform work and analysis as to why problem occurred and how it could have been prevented.
  - b. Describe common reasons for parts failure and be able to discuss symptoms of wear, corrosion, etc., of actual parts.
  - c. Demonstrate ability to follow reference information, test, and determine if unit is within specifications for a hydraulic/hydrostatic trainer or equipment with a hydrostatic drive using service manuals/information/software; demonstrate ability to follow a diagnostic troubleshooting chart for a specific system.
  - d. Demonstrate technical write-up competency
    - Demonstrate logic and critical thinking in identifying, evaluating and diagnosing customer complaint.
    - Identify the root cause of failure
    - Correction procedure
    - Machine inspection

# TECHNICAL ELECTIVE COURSES

**Course Number and Name:**        **DET 1213        Hydraulic Brake Systems**

**Classification:**                                Technical Elective

**Description:**                                This is a course designed to provide diagnosis and repair of hydraulic brake systems, includes instruction in hydraulic and mechanical systems, power assist units, and antilock braking systems.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
3	2	2	60

**National Assessment:**

**Prerequisite:**                                Instructor Approved

**Student Learning Outcomes:**

1. Explore and perform hydraulic brakes diagnosis and repair.
  - a. Identify poor stopping, premature wear, pulling, dragging, balance, or pedal feel problems caused by the hydraulic system; determine needed action.
  - b. Check brake pedal pushrod length; adjust as needed.
  - c. Inspect and test master cylinder for internal/external leaks and damage; replace as needed.
  - d. Inspect hydraulic system, brake lines, flexible hoses, and fittings for leaks and damage; replace as needed.
  - e. Inspect and test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; replace as needed.
  - f. Inspect disc brake caliper assemblies; replace as needed.
  - g. Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type.
  
2. Perform diagnosis and repair of mechanical/foundation systems.
  - a. Identify poor stopping, brake noise, premature wear, pulling, grabbing, dragging, or pedal feel problems caused by mechanical components; determine needed action.
  - b. Inspect and measure rotors; perform needed action.
  - c. Inspect and measure disc brake pads; inspect mounting hardware; perform needed action.
  - d. Check parking brake operation; inspect parking brake application and holding devices; adjust and replace as needed.
  
3. Discuss and perform power assist units diagnosis and repair.
  - a. Identity stopping problems caused by the brake assist (booster) system; determine needed action.
  - b. Inspect, test, repair, or replace hydraulic power brake assist (booster), hoses, and control valves; determine proper fluid type.
  - c. Check emergency (back-up, reserve) brake assist system.
  
4. Discuss and perform hydraulic antilock brake systems (ABS) and automatic traction control (ATC) diagnosis and repair.
  - a. Observe antilock brake system (ABS) warning light operation (includes dash mounted trailer ABS warning light); determine needed action.
  - b. Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action.
  - c. Identify poor stopping and wheel lock-up problems caused by failure of the antilock brake system (ABS); determine needed action.

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- d. Test and check operation of antilock brake system (ABS) air, hydraulic, electrical, and mechanical components; perform needed action.
  - e. Test antilock brake system (ABS) wheel speed sensors and circuits; adjust or replace as needed.
  - f. Bleed the ABS hydraulic circuits following manufacturers' procedures.
  - g. Observe automatic traction control (ATC) warning light operation; determine needed action.
  - h. Diagnose automatic traction control (ATC) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action.
5. Discuss and perform inspection, lubrication, and replacement of wheel bearings.
- a. Clean, inspect, lubricate and replace wheel bearings and races/cups; replace seals and wear rings; inspect spindle/tube; inspect and replace retaining hardware; adjust wheel bearings.
  - b. Inspect or replace extended service wheel bearing assemblies.
6. Discuss and perform hydraulic brake diagnosis and repair.
- 1) Check master cylinder fluid level and condition.
  - 2) Inspect brake lines, fittings, flexible hoses, and valves for leaks and damage.
  - 3) Check parking brake operation; inspect parking brake application and holding devices; adjust as needed.
  - 4) Check operation of hydraulic system: pedal travel, pedal effort, pedal feel (drift).
  - 5) Inspect calipers for leakage and damage.
  - 6) Inspect power brake assist system (booster), hoses and control valves; check brake assist reservoir fluid level and condition.
  - 7) Inspect and record brake lining/pad condition, thickness, and contamination.
  - 8) Inspect and record condition of brake rotors.
  - 9) Adjust drum brakes.
  - 10) Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing.

### ASE Student Certification Standards

#### B. Hydraulic Brakes

##### 1. *Hydraulic System*

1. Identify poor stopping, premature wear, pulling, dragging, balance, or pedal feel problems caused by the hydraulic system; determine needed action.
2. Check brake pedal pushrod length; adjust as needed.
3. Inspect and test master cylinder for internal/external leaks and damage; replace as needed.
4. Inspect hydraulic system brake lines, flexible hoses, and fittings for leaks and damage; replace as needed.
5. Inspect and test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; replace as needed.
6. Inspect and test brake pressure differential valve and warning light circuit switch, bulbs, wiring, and connectors; repair or replace as needed.
7. Inspect disc brake caliper assemblies; replace as needed.
8. Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type.

##### 2. *Mechanical/Foundation*

1. Identify poor stopping, brake noise, premature wear, pulling, grabbing, dragging, or pedal feel problems caused by mechanical components; determine needed action.
2. Inspect and measure rotors; perform needed action.
3. Inspect and measure disc brake pads; inspect mounting hardware; perform needed action.
4. Check parking brake operation; inspect parking brake application and holding devices; adjust and replace as needed.

##### 3. *Power Assist Units*

1. Identify stopping problems caused by the brake assist (booster) system; determine needed action.
2. Inspect, test, repair, or replace hydraulic brake assist (booster), hoses, and control valves; determine proper fluid type.

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3. Check emergency (back-up, reserve) brake assist system.
- C. Air and Hydraulic Antilock Brake Systems (ABS) and Automatic Traction Control (ATC)
1. Observe antilock brake system (ABS) warning light operation (includes dash mounted trailer ABS warning light); determine needed action.
  2. Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action.
  3. Identify poor stopping and wheel lock-up problems caused by failure of the antilock brake system (ABS); determine needed action.
  4. Test and check operation of antilock brake system (ABS) air, hydraulic, electrical, and mechanical components; perform needed action.
  5. Test antilock brake system (ABS) wheel speed sensors and circuits; adjust or replace as needed.
  6. Bleed the ABS hydraulic circuits following manufacturers' procedures.



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**Course Number and Name:**           **DET 291(1-6)    Special Problem/Projects in Diesel Equipment Technology**

**Classification:**                        Technical Elective

**Description:**                         A course to provide students with an opportunity to utilize skills and knowledge gained in other Diesel Equipment Repair and Service courses. The instructor and student work closely together to select a topic and establish criteria for completion of the project.

**Hour Breakdown:**

Semester Hours	Lecture	Lab	Contact Hours
1		2	30
2		4	60
3		6	90
4		8	120
5		10	150
6		12	180

**National Assessment:**               None

**Prerequisite:**                         Instructor Approved

**Student Learning Outcomes:**

1. Develop a written plan which details the activities and projects to be completed.
  - a. Use a written plan which details the activities and projects to be completed.
  - b. Perform written occupational objectives in the special problem.
  
2. Assess accomplishment of objectives.
  - a. Prepare daily written assessments of accomplishment of objectives.
  - b. Present weekly written reports to the instructor of activities performed and objectives accomplished.
  
3. Use and follow a set of written guidelines for the special problem.
  - a. Develop and follow a set of written guidelines for the special problem.

**VALIDATION COPY**

**Course Number and Name:** DET 292(1-6) Supervised Work Experience in Diesel Equipment Technology

**Classification:** Technical Elective

**Description:** A course which is a cooperative program between industry and education designed to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of one semester hour per 45 industrial contact hours.

**Hour Breakdown:**

Semester Hours	Lecture	Externship	Contact Hours
1		3	45
2		6	90
3		9	135
4		12	180
5		15	225
6		18	270

**National Assessment:** None

**Prerequisite:** Instructor Approved

**Student Learning Outcomes:**

1. Follow a set of instructor-written guidelines for the supervised work experience program.
2. Apply skills needed to be a viable member of the workforce.
  - a. Prepare a description of skills to be developed in the supervised work experience program.
  - b. Practice skills needed to be a viable member of the workforce.
3. Practice human relationship skills in the supervised work experience program.
4. Practice positive work habits, responsibilities, and ethics.
5. Develop written occupational objectives in the supervised work experience program.
6. Assess performance of occupational skills.
  - a. Prepare daily written assessments of work performance as specified in the occupational objectives.
  - b. Present weekly written reports to the instructor of activities performed and objectives accomplished.

**AED Standards**

Demonstrate knowledge of the following:

1b. Administrative

1b.3 Awareness of dealership goals, objectives and policies

- a. Exhibit the ability to work toward achieving established goals while in a diversified environment.
- b. Recognize organizational chart.
- c. Demonstrate understanding of how product support activities contribute to the overall profitability of the company.
- d. Identify expense control requirements.
- e. Maintain awareness of sexual harassment policy, safety rules, environmental regulations, disciplinary action policy, and equal opportunity policy.
- f. Explain the need for performance reviews and the impact of different performance levels.
- g. Maintain confidentiality as required

1b.4 Define and Exhibit the ability to communicate to coworkers and customers in a courteous, professional manner.

- a. Demonstrate time management and organizational skills.
- b. Develop an awareness of stressful situations, and the ability to handle and resolve problems with difficult internal and external customers.

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- c. Exhibit the ability to listen and follow verbal and written instructions.
  - d. Respect authority and accept the responsibilities of the position.
  - e. Demonstrate proper appearance to dealer standards.ic business practices
- 1b.5 Describe functions of the dealership service department; explain department goals and procedures
- a. Identify and establish both short and long-term goals and the requirements to achieve them (business and personal).
  - b. Describe parts inventory control, procurement and accountability.
  - c. Demonstrate knowledge of factors that can determine shop labor rates.
  - d. Demonstrate the ability to accurately complete work orders/repair orders and other related reports, including parts and consumables.
  - e. Demonstrate the ability to write a thorough and comprehensive service report.
  - f. Describe tool procurement procedures.
  - g. Describe time tracking.
  - h. Demonstrate the ability to use correct industry terminology.

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**Course Number and Name:** WBL 191(1-3), WBL 192(1-3), WBL 193(1-3), WBL 291(1-3), WBL 292(1-3), and WBL 293(1-3) Work-Based Learning I, II, III, IV, V, and VI

**Classification:** Technical Elective

**Description:** A structured work-site learning experience in which the student, program area teacher, work-based learning coordinator, and work-site supervisor/mentor develop and implement an educational training agreement. This site is designed to integrate the student's academic and technical skills into a work environment, and may include regular meetings and seminars with school personnel for supplemental instruction and progress reviews.

**Hour Breakdown:**

Semester Hours	Lecture	Externship	Contact Hours
1		3	45
2		6	90
3		9	135

**National Assessment:** None

**Prerequisite:** Instructor Approved

**Student Learning Outcomes:**

1. Apply technical skills and related academic knowledge needed to be a viable member of the workforce.
  - a. Demonstrate technical skills necessary to complete job requirements.
  - b. Demonstrate academic skills necessary to complete job requirements.
  - c. Perform tasks detailed in an educational training agreement at the work setting.
  
2. Apply general workplace skills to include positive work habits necessary for successful employment.
  - a. Demonstrate appropriate human relationship skills in the work setting to include conflict resolution, team participation, leadership, negotiation, and customer/client service.
  - b. Utilize time, materials, and resource management skills.
  - c. Use critical thinking skills such as problem solving, decision making, and reasoning.
  - d. Acquire, evaluate, organize, maintain, interpret, and communicate information.

## RECOMMENDED TOOLS AND EQUIPMENT

### CAPITALIZED ITEMS

1. Student Tool Kit (1 kit per 2 students)
  - a. Adjustable wrenches (6" and 12") (2)
  - b. Allen wrench sets, standard (.050" – 3/8") and metric (2mm – 7mm)
  - c. Brake spoon
  - d. Chisels – cape (5/16") and cold (3/8" & 3/4")
  - e. Claw type pickup tool
  - f. Combination wrench sets – standard (1/4" – 1") and metric (7mm – 19 mm)
  - g. Continuity test light (12v)
  - h. Feeler gauge (blade type) (.002" – .040") and (.006 mm – .070 mm)
  - i. Hack saw
  - j. Hammer – 16 oz. ball peen
  - k. Hammer plastic tip
  - l. Ignition wrench set – US and metric
  - m. Magnetic pickup tool
  - n. Pliers, combination 6", locking jaw, needle nose, side cutting, and slip joint (water pump)
  - o. Punches, center, brass drift, pin (1/8", 3/16", 1/4", 5/16"), and taper (3/8", 1/2", 5/8")
  - p. Scrapers – carbon 1" and gasket 1"
  - q. Screwdrivers – standard (stubby, 6", 9", 12", and offset) and Phillips (stubby #1, #2; 6" #1, #2; 12" #3)
  - r. Screw starters – standard and Phillips
  - s. Socket – set – 1/4" drive: 1/4" – 1/2" standard sockets, 1/4" – 1/2" deep sockets, 6mm – 12mm standard sockets, 6mm – 12mm deep sockets, flex/universal type handle, 3" and 6" extensions, ratchet
  - t. Socket set – 3/8" drive: 5/16" – 3/4" standard sockets; 3/8" – 3/4" deep sockets; 9mm – 19mm standard sockets; 9mm – 19mm deep sockets; 3", 6", 12", and 18" extensions; flex head ratchet; ratchet; speed handle; universal joint; spark plug sockets (5/8" and 13/16")
  - u. Socket set – 1/2" drive: 7/16" – 1 1/8" standard sockets; 7/16" – 1 1/8" deep sockets; 10mm – 25mm standard sockets; 10mm – 25mm deep sockets; 3", 6", and 12" extensions; flex/universal type handle, ratchet
  - v. Spark plug feeler gauge (gap tool)
2. Motorized forklift (Minimum: 5000# lift capacity)
3. Air compressor and hoses (1 per program)
4. Axle stands (6 sets per program)
5. Bench or pedestal grinder (2 per program)
6. Computer scan tool (hand-held) – on-board diagnostics level II (4 per program of various brands)
7. Diesel/gasoline fuel pressure testing gauge set with adaptors (1 per program)
8. Hoist(s), engine (Min. 2 ton) (1 per program)
9. Hydraulic press with adapters (25 ton) (1 per program)
10. Master puller set (1 per program)
11. Microcomputer with monitor, printer (CD-ROM and cables) (6 per program)
12. Microcomputer service information software (CD-ROM) (1 per computer)
13. Parts cleaning tank (Heated and EPA Approved) (1 per program)
14. Steel top workbenches with vises (1 per 2 students)
15. Tap and die set (US and metric) (2 per program)
16. Tire mounting machine (1 per program)
17. Wheel balancer (1 per program)
18. Brake lathe with disc service attachments with large vehicle attachments (1 per program)
19. Refrigerant recovery/recycling machine (R-12) (1 per program)
20. Refrigerant recovery/recycling machine (HFC-134a) (1 per program)
21. Battery/starter/charging system tester (1 per program)
22. Valve and valve seat resurfacing equipment (1 per program)

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23. Valve spring tester (1 per program)
24. Diesel fuel injector nozzle pop tester (1 per program)
25. Arc/MIG welder with all accessories (1 per program)
26. Fuel system pressure testing gauge with adapters (1 per program)
27. Asbestos containment/removal device (1 per program)
28. 2 post above the ground lift (1 per program)
29. 4 post above the ground lift (with front end alignment capability) (1 per program)
30. Axle bearing nut set (2 3/8 – 4 7/8 inch) - (1 per program)
31. Transmission/power steering fluid recovery/recycling machine (1 per program)
32. Antifreeze recovery/recycling machine (1 per program)
33. Asbestos containment/removal device (1 per program)

### **CAPITALIZED TRAINING EQUIPMENT ITEMS**

1. Brake Trainer
  - a. Air Brake Trainer
  - b. Hydraulic Brake Trainer
  - c. Mechanical Brake Trainer
2. Axles
  - a. Steer Axle
  - b. Drive Axle
3. Diesel Powered Equipment
  - a. Power Units with operational software and service data
  - b. Agriculture/Construction equipment
  - c. Heavy Duty Truck (Semi)
  - d. Medium Duty Truck
4. Electrical/Electronic Trainer with software simulator package
5. Engine Trainer with Dynamometer
6. HVAC Trainer with software simulator package
7. Hydraulic/Pneumatic Trainer with software simulator package
8. Transmission Trainer

### **NON-CAPITALIZED ITEMS**

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

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

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76. Brake spring installers (6 per program)
77. Brake spring pliers (6 per program)
78. Air conditioner service port adapter set (1 per program)
79. Manifold gauge set (2 per program)
80. Antifreeze tester (2 per program)
81. Carburetor plug and angle gauge set (1 per program)
82. Computer carburetor tools (1 per program)
83. Cylinder leakage tester (2 per program)
84. Oxygen sensor socket (2 sets per program)
85. Sending unit socket (1 per program)
86. Sparkplug thread tap (1 per program)
87. Static strip (4 per program)
88. Timing advance light (4 per program)
89. Vacuum/pressure gauge set (2 per program)
90. Transmission jack(s) (1 per program)
91. Transmission holding fixtures (1 per program)
92. Transmission special tools set (1 per program)
93. Alternator service tools (1 per program)
94. Connector pick tool set (1 per program)
95. Wire and terminal repair kit (4 per program)
96. Clutch alignment set (1 per program)
97. Clutch pilot puller set (1 per program)
98. Universal joint tools (1 per program)
99. Valve guide repair unit (1 per program)
100. Valve spring compressor (1 per program)
101. Hydraulic pressure testing gauge (1 per program)
102. Oxyacetylene welding and cutting set (1 per program)
103. Wheel chocks for heavy trucks (2 sets per program)
104. Universal joint press for heavy trucks (1 per program)
105. Twin disk clutch adjustment tool for heavy trucks (1 per program)
106. Axle thread chaser ( 2- 4¼ inch) ( 1 per program)

## RECOMMENDED INSTRUCTIONAL AIDS

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

1. Cart, AV (for TV-VCR) (1)
2. Cart, AV (for overhead projector) (1)
3. Mylar board (1)
4. Internet connection (1)
5. TV – VCR (1)
6. Video out (Microcomputer to TV monitor) (1)
7. Smart board
8. Laptop computer
9. Microcomputer with monitor, printer (CD-ROM and cables) (Instructor use)
10. Light box projector (1 per program)
11. Microsoft Office Software
12. Training simulation software

Additional equipment may be needed as certification requirements change.

## CURRICULUM DEFINITIONS AND TERMS

- Course Name – A common name that will be used by all community colleges in reporting students
- Course Abbreviation – A common abbreviation that will be used by all community and junior colleges in reporting students
- Classification – Courses may be classified as the following:
  - Career Certificate Required Course – A required course for all students completing a career certificate.
  - Technical Certificate Required Course – A required course for all students completing a technical certificate.
  - Technical Elective – Elective courses that are available for colleges to offer to students.
- Description – A short narrative that includes the major purpose(s) of the course
- Prerequisites – A listing of any courses that must be taken prior to or on enrollment in the course
- Corequisites – A listing of courses that may be taken while enrolled in the course
- Student Learning Outcomes – A listing of the student outcomes (major concepts and performances) that will enable students to demonstrate mastery of these competencies

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75% of the time allocated to each course. The remaining 25% of each course should be developed at the local district level and may reflect the following:
  - Additional competencies and objectives within the course related to topics not found in the state framework, including activities related to specific needs of industries in the community college district
  - Activities that develop a higher level of mastery on the existing competencies and suggested objectives
  - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed or revised
  - Activities that include integration of academic and career–technical skills and course work, school-to-work transition activities, and articulation of secondary and postsecondary career–technical programs
  - Individualized learning activities, including work-site learning activities, to better prepare individuals in the courses for their chosen occupational areas
- Sequencing of the course within a program is left to the discretion of the local college. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors. Programs that offer an Associate of Applied Science Degree must include all of the required Career Certificate courses, Technical Certificate courses **AND** a minimum of 15 semester hours of General Education Core Courses. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester. Each community college specifies the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college.
- In order to provide flexibility within the districts, individual courses within a framework may be customized by doing the following:

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- Adding new student learning outcomes to complement the existing competencies and suggested objectives in the program framework
- Revising or extending the student learning outcomes
- Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the Mississippi Community College Board [MCCB] of the change)