
**APPLIED ACADEMIC &
WORKPLACE SKILLS
FOR**



MEDIUM/HEAVY TRUCK TECHNICIANS

**National Automotive Technicians Education Foundation (NATEF)
101 Blue Seal Drive, SE, Suite 101
Leesburg, VA 20176
703-669-6650**

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***With 2007 Truck Task List**

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The contents of this book were developed under a grant from the U.S. Department of Education.
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PREFACE

This work represents a joint effort by the National Automotive Technicians Education Foundation (NATEF) and the Vocational-Technical Education Consortium of States (V-TECS). The examples that are given represent one of many applications of the academic skills. We sincerely hope that they will assist your efforts to apply this research to your own particular needs.

A very special thanks to all the technicians who participated in the workshops and provided the technical expertise to our research effort.

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INTRODUCTION

By V-TECS

Background

The National Automotive Technician Education Foundation (NATEF) of the National Institute for Automotive Service Excellence (ASE) was one of the recipients of a Department of Education grant for the development of business and industry skill standards for the occupations of Automobile Technician, Autobody Technician (now Collision Repair and Refinish), and Medium/Heavy Truck Technician. Since NATEF had already developed Duty/Task Lists and Equipment Lists for these three areas, they proposed to spend their resources on the re-validation of these task lists as well as the identification of the Related Academic Skills embedded in the Automobile, Collision Repair and Refinish, and Medium/Heavy Truck Task Lists.

Rather than do this work in-house, NATEF chose to contract with the Vocational-Technical Education Consortium of States (V-TECS), Southern Association of Colleges and Schools to conduct the analysis. V-TECS was chosen because of its twenty-year history in occupational and task analysis as well as its recent success in using a taxonomy to identify related academic and workplace skills within and across occupations.

Process Used to Identify the Related Academic Skills Embedded in the NATEF Task List for the Medium/Heavy Truck Technician

V-TECS began the process of identifying the related academic skills by meeting with Dr. Patricia Lundquist, NATEF Executive Director, to outline the strategy for conducting the project. It was decided early on that NATEF would identify four different sites around the country where a high concentration of ASE Certified Medium/Heavy Truck Technicians lived and worked. Once these sites were identified, Dr. Lundquist then worked with local teachers and contacts in the automobile and truck repair industry to identify the names of outstanding technicians in the surrounding area. These names, along with a useable address, were given to V-TECS who contacted the technicians and asked if they would participate in a two-day meeting designed to identify the skills. Technicians were offered a small honorarium to offset the pay they would lose by participating in the meeting. This entire project was carried out with the highest level of teamwork between ASE/NATEF and V-TECS and could be described as a perfect partnership in that Dr. Lundquist identified the technicians and V-TECS handled the logistics and conducted the meetings on site along with Dr. Lundquist.

Since eight specialty areas existed within the NATEF Medium/Heavy Truck List, the decision was made to treat the total truck technician task list as follows:

MEETING SITES AND SPECIALTIES ADDRESSED

Meeting No.	Location	Specialties
1	Bessemer State Technical College Bessemer, Alabama	<ul style="list-style-type: none">• Gasoline Engines• Diesel Engines
2	NAVISTAR Engine Plant Melrose Park, Illinois	<ul style="list-style-type: none">• Electrical/Electronics Systems• Heating & Air Conditioning
3	Portland Community College Beaverton, Oregon	<ul style="list-style-type: none">• Drive Train• Preventive Maintenance
4	Miami Valley Career Technology Center Clayton, Ohio	<ul style="list-style-type: none">• Suspension & Steering• Brakes

**TECHNICIANS WHO
PARTICIPATED IN EACH MEETING**

Meeting Location	Participants	
Bessemer, Alabama	<p>Mr. Leevell Dansby Instructor/Coordinator Bessemer State Technical College P. O. Box 308 Bessemer, AL 35021</p> <p>Mr. Ronnie Joe Denton Technician City of Birmingham Garage DEM 515 Sixth Avenue S. Birmingham, AL 35205</p> <p>Mr. T. J. Willings Owner White GMC of Birmingham P. O. Box 1932 Birmingham, AL 35201</p>	<p>Mr. Kenny Miller, Technician Alabama Power Company 600 North 18th Street P. O. Box 2641 GSC 3 Birmingham, AL 35291-0353</p> <p>Mr. Dennis Fussell Technician/Manager White GMC of Birmingham P. O. Box 1932 Birmingham, AL 35201</p> <p>Mr. James Shedd, Instructor Patterson State Technical College 3920 Troy Highway Montgomery, AL 36116-2699</p>
Melrose Park, Illinois	<p>Mr. Grant Baker Pollard Motor Company 2090 N. Mannheim Road Melrose Park, IL 60160</p> <p>Mr. Mark Dahme City International Trucks 4655 South Central Avenue Chicago, IL 60638</p> <p>Mr. Shea Dieter Friend Equipment 11816 South Route 47 Huntley, IL 60142</p>	<p>Mr. Lane Eichhorn Parkland College 2400 West Bradley Avenue Champaign, IL 61821-1899</p> <p>Mr. Bruce Rosenquist Pollard Motor Company 2090 N. Mannheim Road Melrose Park, IL 60160</p>
Beaverton, Oregon	<p>Mr. Kirk Ainslie Portland Freightliner, Inc. 9622 N.E. Vancouver Way P. O. Box 17218 Portland, OR 97217</p> <p>Mr. Hugh Brock, Instructor Portland Community College Rock Creek Campus 17705 N.W. Springville Road Portland, OR 97229</p>	<p>Mr. Jim Elkins Portland Freightliner, Inc. 9622 N.E. Vancouver Way P. O. Box 17218 Portland, OR 97217</p> <p>Mr. Kenneth Fenning DSU Peterbilt/GMC 5555 N. Lagoon Avenue Portland, OR 97208</p>
	Mr. Larry Hummel	Mr. Carl Simons, Trainer

Meeting Location	Participants	
Clayton, Ohio	Heavy Equip. Service Supervisor Holt 5855 Executive Boulevard Huber Heights, OH 45424	Fyda Freightliner 1250 Walcutt Road Columbus, OH 43228
	Mr. Vern Noble Heavy Equipment Mechanic Dayton, OH 45403	Mr. John Stelzer Kirk National Lease Company 800 Vandemark Road Box 4369 Sidney, OH 45365
	Mr. Arthur Schmaltz Miami Valley Career Tech Ctr. 6800 Hoke Road Clayton, OH 45315-9740	

The same basic procedure was followed in each site. The meetings began with an explanation of the project by Dr. Patricia Lundquist followed by an overview of V-TECS and the process to be used by Dr. Ronald D. McCage, Executive Director of V-TECS. The technicians were then introduced to the overall structure of the Snyder Basic/Essential Skills Taxonomy by Dr. McCage, who led the analysis process for the truck technician meetings. During this part of the process, Dr. McCage systematically brought the technicians into the process so that they would become comfortable with it. The technicians were told that they were considered to be the experts and that their role was to tell the team when a language arts, math, or science concept was used in their field. To help them understand the specific definitions of the concepts, V-TECS used three academic experts for each of the four meetings. These experts were: Ms. Barbara Blasch, Mathematics; Dr. Chrysandra Spiceland, Language Arts; and Dr. Trina Boteler, Science. The process involved taking each of the tasks in each of the eight NATEF specialty areas and asking the technicians to identify the language arts, math and science skills needed to perform each task. Their responses were recorded using the Snyder Taxonomy codes and then put into a data base. At the end of the meetings each technician was also asked to rate each item on a list of Workplace Skills regarding their importance to their occupational specialty of Medium/Heavy Truck. Sandi Davison, Administrative Assistant for V-TECS, did all of the word processing for the project.

Once all of the meetings had been conducted, a composite or unduplicated list of the related academic codes was assembled for language arts, math, and science along with a table representing the most important workplace skill statements identified. Specific statements were then written for each of the codes with an emphasis on how the skill was used in the occupation. After this was accomplished, a more generic list was developed for the general public as well as a transformation of the comprehensive coded list into the eight specialty lists that were specific to each of the eight areas. A matrix was then built showing the relationship between the composite list and each of the eight sublists. Several crosschecks and reviews were made to insure the accuracy of the statement as well as its relationship to each of the areas. The task by task analysis data and the Workplace Skills data was also provided to NATEF as documentation for the process. For a clearer understanding of these various lists, the following items represent an entry for each skill category for the medium/heavy truck technician occupation.

LA001 Adapts Diction/Structure

- The technician adapts diction and structure to the context of all verbal and written communication, based on the audience, purpose, and specific situation.

MA001 Calculates/Evaluates Algebraic Expressions

- The technician can identify when to use Ohm's Law to determine circuit parameters that are out-of-tolerance.

SC007 Analyzes/Evaluates Environmental Issues

- The technician uses government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of waste products.

The following pages contain this information in a variety of formats as identified within the specific areas.

WORKPLACE SKILLS

IDENTIFIED AS BEING IMPORTANT BY THE NATEF
MEDIUM/HEAVY TRUCK TECHNICIANS RELATED ACADEMIC SKILLS COMMITTEE
FROM THE V-TECS/ILLINOIS WORKPLACE SKILLS LIST

A. DEVELOPING AN EMPLOYMENT PLAN

1. Match interests to employment area.
2. Match aptitudes to employment area.
3. Match attitudes to a job area.
4. Match physical capabilities to a job area.
5. Demonstrate a drug-free status.

B. SEEKING AND APPLYING FOR EMPLOYMENT OPPORTUNITIES

1. Locate employment opportunities.
2. Identify job requirements.
3. Evaluate job opportunities.
4. Prepare a resume.
5. Write job application letter.
6. Complete job application form.
7. Prepare for job interview.
8. Dress for job interview.

C. ACCEPTING EMPLOYMENT

1. Apply for social security number.
2. Complete state and federal tax forms.
3. Complete employees withholding allowance certificate Form W-4.

D. COMMUNICATING ON THE JOB

1. Communicate orally with others.
2. Ask questions about task.
3. Follow written and oral directions.
4. Prepare written communication.
5. Use telephone etiquette.

E. INTERPRETING THE ECONOMICS OF WORK

1. Describe responsibilities of employee.
2. Describe responsibilities of employer or management.

F. MAINTAINING PROFESSIONALISM

1. Participate in employment orientation.
2. Treat people with respect.
3. Exhibit positive behavior.
4. Comply with organizational expectations.
5. Comply with company dress and appearance standards.
6. Use job-related terminology.
7. Participate in meetings in a positive and constructive manner.

G. ADAPTING/COPING WITH CHANGE

1. Identify the elements of the job transition.
2. Exhibit ability to handle stress.
3. Recognize need to change or quit a job.

H. SOLVING PROBLEMS AND CRITICAL THINKING

1. Clarify purposes and goals.
2. Identify the problem.
3. Employ reasoning skills.
4. Assess employer and employee responsibility in solving a problem.
5. Evaluate options.
6. Estimate results of implemented options.
7. Set priorities.
8. Identify solutions to the problem and their impact.
9. Select and implement a solution to a problem.
10. Prioritize and organize workloads.

I. MAINTAINING A SAFE AND HEALTHY ENVIRONMENT

1. Follow conservation/environmental practices and policies.
2. Comply with safety and health rules/procedures.
3. Identify hazardous substances in the work place.
4. Use and maintain proper tools and equipment.
5. Maintain work area.
6. Act during emergencies.

J. DEMONSTRATING WORK ETHICS AND BEHAVIOR

1. Follow rules, regulations and policies as established.
2. Implement responsibilities of job position.
3. Maintain regular attendance.
4. Assume responsibility for decisions and actions.
5. Demonstrate willingness to learn.
6. Practice time management.
7. Practice cost effectiveness.
8. Apply ethical reasoning.
9. Display initiative.
10. Display assertiveness.
11. Exhibit pride.

K. DEMONSTRATING TECHNOLOGY LITERACY

1. Demonstrate basic knowledge of computing.
2. Recognize impact of technological changes on tasks and people.
3. Demonstrate basic keyboarding skills.

L. MAINTAINING INTERPERSONAL RELATIONSHIPS

1. Value individual diversity.
2. Respond to praise or criticism.
3. Provide constructive praise or criticism.
4. Channel and control emotional reactions.
5. Resolve conflicts.
6. Display a positive attitude.
7. Identify and react to sexual intimidation/harassment.

M. DEMONSTRATING TEAMWORK

1. Identify style of leadership used in teamwork.
2. Match team member's skills and group activity.
3. Work with team members.
4. Complete a team task.
5. Evaluate outcomes.

**NARRATIVE FOR LANGUAGE ARTS RELATED ACADEMIC SKILLS
for all
NATEF Medium/Heavy Truck Technician Task Lists**

The medium/heavy truck technician must be proficient in the following Language Arts and Communications Related Academic Skills that are embedded in the occupation. Using these skills the technician must be able to:

- Request, collect, comprehend, evaluate, and apply oral and written information gathered from customers, associates, and supervisors regarding symptoms and potential solutions to problems.
- Identify the purpose for all written and oral communication and then choose the most effective strategies for listening, reading, speaking, and writing to facilitate the communication process.
- Adapt a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, etc., relevant to problem identification, diagnosis, solution, and repair.
- Attend to verbal and nonverbal cues in discussions with customers, supervisors, and associates to verify, identify, and solve problems.
- Use study habits and techniques, i.e. previewing, scanning, skimming, taking notes, etc., when reviewing publications (shop manuals, references, databases, operator's manuals, and text resources) for problem solving, diagnosis, and repair.
- Use prior knowledge learned from solving similar problems to diagnose and repair the immediate problem.
- Write clear, concise, complete, and grammatically accurate sentences and paragraphs.
- Write warranty reports and work orders to include information regarding problem resolution and the results of the work performed for the customer or manufacturer.
- Comprehend and apply industry definitions and specifications to diagnose and solve problems in all truck components and systems.
- Follow all oral/written directions that relate to the task or system under study.
- Comprehend and use problem-solving techniques and decision trees that are contained in service manuals to determine cause-and-effect relationships.
- Scan service manuals and databases to locate specific information for problem-solving purposes.
- Use the service manual to identify the manufacturer's specifications for system parameters, operation, and potential malfunctions.
- Interpret charts, tables, or graphs to determine the manufacturer's specifications for system operation to identify out-of-tolerance systems and subsystems.
- Supply clarifying information in oral and written form to customers, associates, parts supplier, and supervisors.

NARRATIVE FOR MATHEMATICS RELATED ACADEMIC SKILLS
for all
NATEF Medium/Heavy Truck Technician Task Lists

The medium/heavy truck technician must be proficient in the following Mathematics Related Academic Skills that are embedded in the occupation. Given these skills the technician must be able to:

- Determine the proper sequence of arithmetic operations to arrive at a solution to a problem that can be compared to other specifications when comparing system measurements to the manufacturer's specifications.
- Add two or more whole numbers, fractions, or decimals to determine component conformance of multiple measurements with the manufacturer's specifications of the truck or trailer.
- Subtract whole numbers, fractions, or decimals to arrive at a difference for comparison with the truck manufacturer's specifications.
- Divide decimals to determine measurement conformance with the truck manufacturer's specifications.
- Convert variables presented orally to a mathematical form that provides for an algebraic solution.
- Estimate the results of basic arithmetic operations, and accurately round up or down depending on the appropriate rule for the situation.
- Analyze and solve problems requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.
- Determine the irrelevant and/or missing data needed to solve a problem.
- Determine and interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.
- Use Centigrade or Fahrenheit measurement scales to determine the existing temperature of substances such as a coolant or lubricant.
- Use English and metric volume measurement techniques to determine the volume of a system, component, or cylinder.
- Use conventional symbols (E for voltage, etc.) to solve circuit parameter calculations using formulas such as Ohm's Law, $E=IR$.
- Understand that if the described problem has certain conditions (symptoms), then a limited number of solutions to the problem apply.
- Understand the relationship between the frequency of the occurrence of a problem (symptom) and the probability of accurately predicting the problem.
- Calculate the average (mean) of several measurements to determine the variance from the manufacturer's specifications.
- Use English and metric angle and distance measurements and techniques to determine angle variances from the truck manufacturer's specifications.
- Solve problems that involve determining the relative proportion of desired versus undesired ingredients or elements of a mixture, and determine if that proportion is within the manufacturer's specifications.
- Comprehend and use standards defined by each manufacturer for the system being analyzed.

- Convert test readings that are in decimal or fraction form to a ratio or percent for comparison with the manufacturer's specifications for the sub-system.
- Know when to use an estimated performance value versus an exact value, basing the decision on the system being analyzed or repaired.
- Visually perceive the geometric relationship of systems and sub-systems that require alignment.
- Construct or interpret a chart, table, graph, or symbol that depicts a range of performance characteristics that can be used for comparing various system operational conditions.
- Use precision measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle components requiring geometric alignment.
- Use formulas to indirectly confirm systems that are outside of the manufacturer's specifications.
- Verify that the relationship between parallel lines and angles concurs with the manufacturer's specifications when diagnosing a system's malfunction.
- Visually formulate an angle (e.g., belt/suspension/drive) and verify conformance to the manufacturer's specified angle.
- Measure timed or sequenced operating parameters to determine conformance with the manufacturer's specifications of the truck.
- Use English and metric scales to determine the conformance of components to the manufacturer's specified weight of the truck.
- Determine the degree of conformance to the manufacturer's specifications for length, volume, and other appropriate measurements in the English and/or metric system.
- Distinguish the congruence of the measured tolerances with those specified by the manufacturer.
- Measure and/or test with tools designed for English or metric measurements, then convert the result to the manufacturer's system used for specifying the correct measurement or tolerance.
- Compute mentally whether the observed measurement is out-of-tolerance when comparing the observed measurement to the manufacturer's specifications.
- Solve problems that involve determining whether the proportion of the existing volume compares to the manufacturer's specifications and is within the recommended tolerance.
- Distinguish whether a measurement or tolerance is equal or not equal to the manufacturer's specifications.
- Solve basic and complex algebraic expressions.

NARRATIVE FOR SCIENCE RELATED ACADEMIC SKILLS
for all
NATEF Medium/Heavy Truck Technician Task Lists

The medium/heavy truck technician must be proficient in the following Science Related Academic Skills that are imbedded in the occupation. Using these skills the technician must be able to:

- Analyze and evaluate waste products from the repair task and dispose of the parts, residue, or trash according to applicable federal, state, and local rules and regulations.
- Follow all safety regulations and procedures while performing any task.
- Use the information provided in service manuals, charts, tables, or graphs to determine the manufacturer's specifications for system(s) operation(s) and the appropriate repair/replacement procedure.
- Develop a hypothesis regarding the cause of the problem and test the hypothesis to determine the solution to the problem.
 1. identify the problem
 2. gather information
 3. develop hypothesis
 4. take action
 5. check results
- Convert measurements taken using the English or metric system to specifications stated in terms of either system.
- Explain and demonstrate an understanding of the chemical reaction that occurs in various systems of a truck regarding the combustion of fuels, catalytic converters, and contamination when introduced into a given system.
- Explain the purpose of additives in truck fuels and lubricants.
- Demonstrate an understanding and determine efficiency of the kinetic and potential energy relationships that occur in valve systems, ignition systems, and other stored energy systems, such as springs and fuels.
- Demonstrate an understanding of the role of balanced and unbalanced forces on linear and rotating truck assemblies.
- Explain the relationship of centrifugal/centripetal force to the failure of rotating systems.
- Explain the ignition characteristics of gasoline and diesel fuels resulting from varying levels of fractional distillation.
- Demonstrate an understanding of how gasoline and diesel fuel characteristics affect combustion in a truck engine.
- Demonstrate an understanding of the effect of heat on various truck systems.
- Explain the concept of heat transfer in terms of conduction, convection, and radiation in truck systems.
- Demonstrate an understanding of the expansion and contraction of system parts as a result of heat generated during use and the cooling of the system when not in operation.
- Demonstrate an understanding of the effect that adding heat will cause in a state of matter, such as solid to liquid to gas.
- Explain the role of insulation in maintaining stable temperatures and in the deadening of sound.

- Demonstrate an understanding of the principles of light and light refraction and reflection.
- Demonstrate an understanding of refraction in fiber optic systems.
- Explain that when dye is added to engine oil or other lubricants an ultraviolet light can be used to detect leaks by shining light in suspected areas.
- Demonstrate an understanding of the process of acceleration and deceleration as a function of weight and available power.
- Demonstrate how fluid can be used to produce motion in a valve or piston assembly.
- Demonstrate an understanding of the circular motion of a truck component as it relates to such concepts as toe-out on turns and tracking.
- Demonstrate an understanding of the types of vibrations caused by out-of-balance or excessively worn components.
- Explain to a customer how sound can be amplified due to resonant cavities and other physical characteristics of the vehicle.
- Explain and demonstrate an understanding of how sound generated in one place in the body, chassis, and/or engine can be carried to other parts of the truck through metal and/or other materials.
- Explain the need for sound deadening and vibration damping materials to control the level of sound in the passenger compartment.
- Demonstrate an understanding of the relationship of the perceived intensity to the decibel level of a noise.
- Explain the relationship of the frequency of the sound to a normal or abnormally operating system.
- Explain and demonstrate an understanding of the role of listening to sounds as part of the trouble-shooting process.
- Explain that the presence of overtones may indicate changes in the vibrations of various truck components.
- Demonstrate an understanding of the relationship of barometric pressure to engine performance (horsepower).
- Explain the relationship of engine torque to overall truck performance.
- Explain how levers and pulleys can be used to increase an applied force or distance.
- Identify the characteristics that define a system that is operating within the manufacturer's specifications.
- Use precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that repair or replacement parts meet the manufacturer's specifications.
- Use a torque wrench to measure the force or tension required to tighten connections to the manufacturer's specifications.
- Use a scale to measure component weight to balance rotating systems.
- Use pressure measuring tools to determine pressures in hydraulic or pneumatic systems and compare to the manufacturer's specifications.

- Use direct and indirect methods to measure system temperatures and then convert to Fahrenheit/Centigrade as required.
- Use direct and indirect methods to measure time and compare the results to the truck manufacturer's specifications.
- Use direct and indirect methods to measure the volume of liquids in a system and compare to the truck manufacturer's specifications.
- Use computer databases for information retrieval and input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.
- Explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location.
- Explain catalytic converter principles which modify emission gases at the atomic level to provide a low level of HC, CO, and NO_x in the final exhaust.
- Explain the role that friction plays in acceleration and deceleration of objects as illustrated by transmitting motion to a part not physically connected to the powered part.
- Explain the need for lubrication of adjacent parts to minimize friction as a result of movement at the junction of the parts.
- Explain the necessity of knowing that the hardness of a metal determines, in part, its function and location in the vehicle.
- Explain the dynamic control properties of a hydraulic system.
- Explain the surface processes that occur on system seals due to the absorption of the contained materials.
- Demonstrate an understanding of how the deterioration in an engine's performance can be caused by a chemical reaction that occurs in a liquid that has been contaminated.
- Demonstrate an understanding of how torque relates to force and angular acceleration.
- Demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force.
- Explain how rotational motion is changed to linear motion and the need for balance in rotating systems.
- Demonstrate an understanding of how variances in flow rate in air flow sensors or cooling systems can affect engine performance.

Electrical/Tolerances

- Explain and demonstrate an understanding of the properties of electricity that impact the lighting, engine management, and other electrical systems in the truck.
- Demonstrate an understanding of the characteristics of a quality electrical ground and explain the problems associated with an inadequate electrical circuit ground.

- Explain voltage and current flow in series and parallel circuits.
- Demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.
- Demonstrate an understanding of the role of the alternator in maintaining battery and system voltage.
- Explain and demonstrate an understanding of the ignition coil's role in generating the high voltages required to fire the sparkplug.
- Demonstrate an understanding of the correct procedure used to measure the electrical parameters of voltage, current, or resistance.
- Explain and demonstrate an understanding of the role of a fuse or fusible link as a protective device in an electrical or electronic circuit.
- Explain and demonstrate an understanding of the use of Ohm's Law in verifying circuit parameters (resistance, voltage, amperage).
- Explain and demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.
- Explain and demonstrate an understanding of system voltage generation, uses, and characteristics.
- Demonstrate an understanding of the electron transfer process that occurs in a truck battery.
- Explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.
- Explain the relationship between electrical current in a conductor and the magnetic field produced in a coil such as the starter solenoid.
- Explain the ability of a coil to increase battery voltage to the level required to fire a sparkplug.
- Explain the effect of magnetic fields on unshielded circuits in selected control modules.
- Explain the need for a specific gravity test of battery electrolyte to determine charge.
- Use precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power.
- Demonstrate an understanding of the role of capacitance in timer circuits, such as RC timers or MAP sensors, where the changing manifold pressure causes two metal discs to act like a capacitor by sending varying voltage to the electronic engine control system.
- Demonstrate an understanding of the capacity of semiconductor devices to modify rapidly engine operation parameters depending on multiple inputs from engine operational sensors.
- Explain how the movement of a conductor in a magnetic field can generate electricity.
- Demonstrate an understanding of the role of mechanical transducers in sending electrical control signals to modify system operating characteristics.
- Demonstrate an understanding of the purpose of photocells and measurement processes relative to determining output.

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE LANGUAGE ARTS/COMMUNICATIONS SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
LA001	Adapts Diction/Structure	●	●	●	●	●	●	●	
LA005	Adapts Strategy Listening	●	●	●	●	●	●	●	
LA006	Adapts Strategy Reading	●	●	●	●	●	●	●	●
LA007	Adapts Strategy Speaking	●	●	●	●	●	●	●	
LA008	Adapts Strategy Writing	●	●	●	●	●	●	●	
LA009	Adapts Style Purpose	●	●	●	●	●	●	●	
LA013	Applies/Uses Definitions	●	●	●	●	●	●	●	●
LA020	Applies/Uses Study Habits/Methods	●	●	●	●	●	●	●	●
LA022	Applies/Uses Study Habits/Methods Prior Knowledge	●	●	●	●	●	●	●	●
LA023	Applies/Uses Study Habits/Methods Skimming/Scanning	●	●	●	●	●	●	●	●
LA035	Attends Directions/Task	●	●	●	●	●	●	●	●
LA036	Attends Nonverbal Cues	●	●	●	●	●	●	●	
LA037	Attends Verbal Cues	●	●	●	●	●	●	●	
LA038	Collects/Organizes Information-Oral/Written	●	●	●	●	●	●	●	●
LA069	Composes/Edits Notes	●	●	●	●	●	●	●	●
LA074	Composes/Edits Paragraphs	●	●	●	●	●	●	●	●
LA098	Composes/Edits Reports Summaries	●	●	●	●	●	●	●	
LA099	Composes/Edits Sentences	●	●	●	●	●	●	●	●
LA121	Comprehends Information-Oral	●	●	●	●	●	●	●	
LA132	Comprehends Information-Written	●	●	●	●	●	●	●	●
LA134	Comprehends Information-Written Cause/Effect Relationships	●	●	●	●	●	●	●	●

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE LANGUAGE ARTS/COMMUNICATIONS SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
LA136	Comprehends Information-Written Charts/Tables/Graphs	●	●	●	●	●	●	●	●
LA147	Comprehends Information-Written Sequence	●	●	●	●	●	●	●	●
LA167	Evaluates Information-Oral	●	●	●	●	●	●	●	
LA180	Evaluates Information-Written	●	●	●	●	●	●	●	●
LA215	Identifies Information-Written Abbreviations/Acronyms	●	●	●	●	●	●	●	●
LA231	Identifies Purpose/Strategy Listening/Reading/Speaking/Writing	●	●	●	●	●	●	●	●
LA236	Infers/Predicts Information-Oral	●	●	●	●	●	●	●	
LA247	Infers/Predicts Information-Written	●	●		●		●	●	
LA256	Infers/Predicts Information-Written Outcomes/Solutions	●	●	●	●	●	●	●	●
LA266	Presents Informal Speech Information Requests	●	●	●	●	●	●	●	
LA267	Presents Informal Speech Information Supplying	●	●	●	●	●	●	●	
LA278	Uses Text Resources	●	●	●	●	●	●	●	●
LA283	Uses Media Resources Databases	●	●	●	●	●	●	●	●
LA285	Comprehends Information-Written Operator's Manual	●	●	●	●	●	●	●	●
LA286	Uses Text Resources Service (Shop) Manual	●	●	●	●	●	●	●	●

LANGUAGE ARTS/COMMUNICATIONS RELATED ACADEMIC SKILLS
for the
NATEF Medium/Heavy Truck Technician Task List

- LA001 Adapts Diction/Structure
 - The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.
- LA005 Adapts Strategy Listening
 - The technician adapts a listening strategy that will provide the information required for solving the problem.
- LA006 Adapts Strategy Reading
 - The technician adapts a reading strategy for all written materials, e.g., customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the problem.
- LA007 Adapts Strategy Speaking
 - The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for use in problem solving.
- LA008 Adapts Strategy Writing
 - The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.
- LA009 Adapts Style Purpose
 - The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.
- LA013 Applies/Uses Definitions
 - The technician can apply industry definitions to solve problems in various components and systems of the truck.
- LA020 Applies/Uses Study Habits/Methods
 - The technician uses study habits and methods when consulting the manufacturer's publications, e.g., shop manuals, references, and computer databases related to the truck.
- LA022 Applies/Uses Study Habits/Methods Prior Knowledge
 - The technician uses prior knowledge of similar situations to determine the specific cause(s) of the problem.
- LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
 - The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.
- LA035 Attends Directions/Task
 - The technician attends to all written and oral directions that relate to the task or system of the truck under study.
- LA036 Attends Nonverbal Cues
 - The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.
- LA037 Attends Verbal Cues
 - The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.

- LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.
- LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.
- LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.
- LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.
- LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.
- LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.
- LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.
- LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a component or system.
- LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for component or system alignment.
- LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.
- LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a problem.
- LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information when analyzing a problem.
- LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.
- LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing

- when dealing with customers, associates, and supervisors.
- LA236 Infers/Predicts Information-Oral
 - The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.
- LA247 Infers/Predicts Information-Written
 - The technician makes inferences and predicts the solution to the problem from the information provided on the work order.
- LA256 Infers/Predicts Information-Written Outcomes/Solutions
 - The technician makes inferences and solves problems from the information provided on the work order.
- LA266 Presents Informal Speech Information Requests
 - The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.
- LA267 Presents Informal Speech Information Supplying
 - The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.
- LA278 Uses Text Resources
 - The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.
- LA283 Uses Media Resources Databases
 - The technician uses computerized and other databases to obtain system information.
- LA285 Comprehends Information-Written Operator's Manual
 - The technician can comprehend and apply information in the operator's manuals to operate and maintain truck tools and equipment.
- LA286 Uses Text Resources Service (Shop) Manual
 - The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and potential malfunctions.

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE MATHEMATICS SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
MA001	Calculates/Evaluates Algebraic Expressions				●	●	●	●	
MA013	Calculates/Evaluates Mean/Median/Mode						●		
MA026	Computes Addition Decimals	●	●	●	●	●	●	●	
MA028	Computes Addition Mentally	●	●	●	●	●	●	●	
MA034	Computes Addition Whole Numbers	●	●	●	●	●	●	●	
MA039	Computes Division Decimals	●	●	●	●	●	●	●	
MA041	Computes Division Mentally	●	●	●	●	●	●	●	
MA047	Computes Division Whole Numbers	●	●	●	●	●	●	●	
MA065	Computes Multiplication Decimals	●	●	●	●	●	●	●	
MA066	Computes Multiplication Fractions	●	●	●	●	●	●	●	
MA067	Computes Multiplication Mentally	●	●	●	●	●	●	●	
MA073	Computes Subtraction Whole Numbers	●	●	●	●	●	●	●	
MA084	Computes Subtraction Decimals	●	●	●	●	●	●	●	
MA086	Computes Subtraction Mentally	●	●	●	●	●	●	●	
MA097	Constructs Charts/Graphs/Tables	●	●	●				●	
MA116	Converts Decimals/Fractions Ratios/Percents	●	●	●	●		●	●	
MA126	Converts Units English/Metric -- Feet/Meters, e.g.	●	●	●	●	●	●	●	
MA128	Distinguishes Angles/Circles/Arcs	●	●	●	●				
MA129	Distinguishes Congruence/Similarity Geometric Figures	●	●	●	●	●			
MA131	Distinguishes Equal/Not Equal	●	●	●	●	●	●	●	
MA132	Distinguishes Estimate/Exact Value	●	●	●	●	●	●	●	

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE MATHEMATICS SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
MA133	Distinguishes Proportion/Congruence	●	●	●	●	●	●	●	
MA140	Estimates/Rounds Expected Outcomes Everyday Occurrences	●	●	●	●	●	●	●	
MA146	Estimates/Rounds Numbers Add/Subtract/Divide/Multiply	●	●	●	●	●	●	●	
MA153	Formulates/Verifies Angles	●	●	●	●	●		●	●
MA161	Identifies English Measures Length/Volume/Weight	●	●	●	●	●	●	●	
MA168	Identifies Lines Parallel/Perpendicular	●	●	●	●	●			
MA171	Identifies Metric Measures Length/Volume/Weight	●	●	●	●	●	●	●	
MA172	Identifies Missing/Irrelevant Data Word Problems	●	●	●	●	●	●	●	
MA174	Interprets Charts/Tables/Graphs	●	●	●	●	●	●	●	●
MA176	Interprets Symbols <, >, =, e.g.	●	●	●	●	●	●	●	●
MA177	Interprets System of Numbers Place Value	●	●	●	●	●	●	●	
MA180	Measures Direct Angles	●	●	●	●	●	●	●	●
MA181	Measures Direct Distance	●	●	●	●	●	●	●	●
MA182	Measures Direct Temperature	●	●				●	●	
MA183	Measures Direct Time	●	●			●	●		
MA184	Measures Direct Volume	●	●	●	●		●	●	●
MA185	Measures Direct Weight	●	●	●	●		●	●	
MA190	Measures Metric Distance	●	●	●	●	●	●	●	
MA191	Measures Metric Temperature	●	●	●			●	●	
MA192	Measures Metric Volume	●	●	●		●			
MA193	Measures Metric Weight	●	●	●			●	●	

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE MATHEMATICS SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
MA228	Solves Problems Fraction/Decimal/Ratio/Percent Direct/Indirect Variation	●	●	●	●	●	●	●	
MA229	Solves Problems Generates Conclusions Deductive Reasoning	●	●	●	●	●	●	●	
MA230	Solves Problems Proportion	●	●	●	●	●	●	●	
MA232	Solves Problems Proportion Volume	●	●	●	●	●		●	
MA239	Understands Conditionals	●	●	●	●	●	●	●	
MA242	Understands Definitions Standards	●	●	●	●	●	●	●	
MA244	Understands Geometric Figures Visual Perception	●	●	●	●	●			
MA245	Understands Line/Angle/Relationships	●	●	●	●	●	●		
MA258	Understands Statistics Probability	●	●	●			●		
MA271	Determines Proper Operation	●	●	●	●	●	●	●	
MA272	Computes Proper Operations	●	●	●	●	●	●	●	
MA273	Computes Tolerances/Ranges Mentally	●	●	●	●	●	●	●	
MA274	Computes Proper Operations Mentally	●	●	●	●	●	●	●	
MA275	Identifies Temperatures Fahrenheit/Centigrade	●	●	●		●	●	●	
MA276	Understands Tolerances Ranges	●	●	●	●	●	●	●	●

MATHEMATICS RELATED ACADEMIC SKILLS
for the
NATEF Medium/Heavy Truck Technician Task List

- MA001 Calculates/Evaluates Algebraic Expressions
 - The technician can use Ohm's Law to determine electrical circuit parameters that are out-of-tolerance.
- MA013 Calculates/Evaluates Mean/Median/Mode
 -The technician can calculate the average (mean) of several different measurements to determine any variance from the manufacturer's specifications
 -
- MA026 Computes Addition Decimals
 -The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA028 Computes Addition Mentally
 -The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.
- MA034 Computes Addition Whole Numbers
 -The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.
- MA039 Computes Division Decimals
 -The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.
- MA041 Computes Division Mentally
 -The technician can mentally divide numbers to determine conformance with the manufacturer's specifications.
- MA047 Computes Division Whole Numbers
 -The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA065 Computes Multiplication Decimals
 -The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA066 Computes Multiplication Fractions
 -The technician can multiply numbers that include fractions to determine conformance with the manufacturer's specifications.
- MA067 Computes Multiplication Mentally
 -The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA073 Computes Subtraction Whole Numbers
 -The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA084 Computes Subtraction Decimals
 -The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.

- MA086 Computes Subtraction Mentally
 -The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.
- MA092 Computes Subtraction Whole Numbers
 -The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA097 Constructs Charts/Graphs/Tables
 -The technician can construct a chart, table, or graph that depicts a range of performance characteristics of various system operational conditions that can be used for comparisons.
- MA116 Converts Decimals/Fractions Ratios/Percents
 -The technician can convert test readings that are in decimal or fraction form to a ratio or percent form for comparison with the manufacturer's specifications.
- MA126 Converts Units English/Metric—Feet/Meters, e.g.
 -The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturer for specifying the correct measurement or tolerance.
- MA128 Distinguishes Angles/Circles/Arcs
 - The technician must be highly skilled in determining if certain angles, circles, or arcs have the proper shape and relationship to each other.
- MA129 Distinguishes Congruence/Similarity Geometric Figures
 - The technician can distinguish whether or not the angle between related parts (e.g. chassis, engine, or suspension components) is within the manufacturer's specifications.
- MA131 Distinguishes Equal/Not Equal
 - The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specifications.
- MA132 Distinguishes Estimate/Exact Value
 - The technician can distinguish the need to use an exact value versus an estimated performance value, depending upon the system malfunction.
- MA133 Distinguishes Proportion/Congruence
 -The technician can distinguish the congruence of measured tolerances with those specified by the manufacturer.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
 - The technician estimates the anticipated performance outcome of a normally operating system as well as expected outcome of everyday occurrences such as the result of electrical parameter being out of conformance with the manufacturer's specifications.
- MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
 -The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.

- MA153 Formulates/Verifies Angles
 -The technician can visually formulate an angle, (e.g. engine, suspension system, cab, or chassis component alignment) and verify its conformance to the manufacturer's specified angle.
- MA161 Identifies English Measures Length/Volume/Weight
 -The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.
- MA168 Identifies Lines Parallel/Perpendicular
 - The technician can use measurement devices to determine the parallelism or perpendicularity of chassis, suspension and other vehicle dimensions requiring geometric alignment principles.
- MA171 Identifies Metric Measures Length/Volume/Weight
 - The technician can determine the degree of conformance to the manufacturer's specifications for length, volume, and other appropriate measurements using the metric system.
- MA172 Identifies Missing/Irrelevant Data Word Problems
 - The technician can discuss symptoms of problems with a customer or associate technician and identify any relevant missing data required to solve the problem.
- MA174 Interprets Charts/ Tables/Graphs
 -The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.
- MA176 Interprets Symbols <, >, =, e.g.
 -The technician interprets symbols to determine compliance with the manufacturer's specifications.
- MA177 Interprets System of Numbers Place Values
 -The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements using micrometers, dial indicators, or other precision gauges.
- MA180 Measures Direct Angles
 - The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.
- MA181 Measures Direct Distance
 - The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.
- MA182 Measures Direct Temperature
 -The technician can use appropriate temperature measurement tools to determine the existing temperature of substances such as a coolant or lubricant.
- MA183 Measures Direct Time
 -The technician needs to know that time is very critical to the proper timing of an engine or other component.
- MA184 Measures Direct Volume
 -The technician can use various measurement methods to determine the volume of selected compounds and solutions.

MA185	Measures	Direct	Weight
	-The technician uses scales to determine whether the weight of a given component is in conformance with the manufacturer's specified weight.		
MA190	Measures	Metric	Distance
	-The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.		
MA191	Measures	Metric	Temperature
	-The technician can use metric temperature measurement instruments to determine ambient air temperature and that of compounds and inhibitors.		
MA192	Measures	Metric	Volume
	-The technician can determine the volume of a system or vessel when the specifications are in liters.		
MA193	Measures	Metric	Weight
	-The technician can use metric weighing devices to determine the conformance of a weight to metric tolerances.		
MA228	Solves Problems	Fraction/Decimal/Ratio/Percent	Direct/Indirect Variation
	-The technician can analyze and solve problems requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.		
MA229	Solves Problems	Generates Conclusions	Deductive Reasoning
	-The technician can identify the specific cause of the described problem by generating conclusions base on known symptoms related to the problem.		
MA230	Solves Problems	Proportion	
	-The technician can solve problems that determine the proportion of variables of a solution and determine if that proportion is within the manufacturer's specifications.		
MA232	Solves Problems	Proportion	Volume
	-The technician can solve problems that involve determining whether the proportion of the existing volume is within recommended tolerance when compared to the manufacturer's specifications.		
MA239	Understands	Conditionals	
	-The technician understands that if the described problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.		
MA242	Understands	Definitions	Standards
	-The technician can use and conform to standards defined by each manufacturer for the system being analyzed.		
MA244	Understands	Geometric Figures	Visual Perception
	-The technician can visually perceive the geometric relationships of systems and sub-systems requiring alignment or verification.		
MA245	Understands	Line/Angle	Relationships
	-The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications when diagnosing the alignment of a cab, trailer, or steering and suspensions systems		

- MA258 Understands Statistics Probability
 -The technician understands that problem symptoms can be statistically related to the probability of specific part or system malfunctioning.
- MA271 Determines Proper Operation
 -The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA272 Computes Proper Operations
 -The technician can accurately compute all arithmetic operations in the proper sequences to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA273 Computes Tolerances/Ranges Mentally
 -When comparing the observed measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.
- MA274 Computes Proper Operations Mentally
 -The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.
- MA275 Identifies Temperatures Fahrenheit/Centigrade
 -The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.
- MA276 Understands Tolerances Ranges
 -The technician can choose the proper tool or instrument to determine if a specific system is within the tolerance or range specified by the manufacturer.

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
SC007	Analyzes/Evaluates Environmental Issues	●	●	●	●	●	●	●	
SC012	Analyzes/Evaluates Environmental Issues Waste Management	●	●	●	●	●	●	●	
SC041	Applies/Uses Laboratory Techniques Safety	●	●	●	●	●	●	●	●
SC042	Applies/Uses Maps/Charts/Tables/Graphs	●	●	●	●	●	●	●	●
SC044	Applies/Uses Scientific Methods	●	●	●	●	●	●	●	●
SC052	Converts Measurement Units English/Metric	●	●	●	●	●	●	●	
SC114	Describes/Explains Chemical Reactions	●	●			●	●	●	
SC121	Describes/Explains Chemical Reactions Inhibitors	●	●	●	●			●	
SC177	Describes/Explains Electricity	●	●			●	●	●	●
SC178	Describes/Explains Batteries						●		
SC180	Describes/Explains Conductors	●	●			●	●	●	
SC182	Describes/Explains Current AC-DC	●	●	●	●	●	●	●	
SC184	Describes/Explains Electricity Ground	●	●	●	●	●	●	●	
SC186	Describes/Explains Electricity Parallel/Series Circuits	●	●	●	●	●	●	●	
SC187	Describes/Explains Electricity Short Circuit	●	●	●	●	●	●	●	
SC194	Describes/Explains Electricity - Generating Motors	●	●	●			●	●	
SC197	Describes/Explains Electricity - Generating Transformers		●				●		
SC198	Describes/Explains Electricity - Measurement	●	●	●	●	●	●	●	●
SC199	Describes/Explains Electricity - Measurement Ammeter/Voltmeter	●	●	●	●	●	●	●	
SC201	Describes/Explains Electricity - Measurement Fuse	●	●	●		●	●	●	
SC204	Describes/Explains Electricity - Measurement Resistance	●	●	●		●	●	●	

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
SC205	Describes/Explains Electricity - Measurement Voltage	●	●	●		●	●	●	
SC211	Describes/Explains Electrochemical Reactions						●		
SC212	Describes/Explains Electrochemical Reactions Activity of Metals	●	●		●	●	●		
SC213	Describes/Explains Electrochemical Reactions Oxidation/Reduction	●	●				●		
SC214	Describes/Explains Electromagnetism	●	●	●	●	●	●	●	
SC215	Describes/Explains Electromagnetism Coil	●	●	●		●	●	●	
SC217	Describes/Explains Electromagnetism Magnetic Fields/Force	●	●	●			●	●	
SC233	Describes/Explains Energy Kinetic/Potential	●	●	●	●	●			
SC249	Describes/Explains Energy Force, Balanced/Unbalanced	●	●	●	●	●		●	
SC250	Describes/Explains Force Centrifugal/Centripetal	●	●	●	●			●	
SC251	Describes/Explains Force Friction	●	●	●	●	●	●	●	
SC255	Describes/Explains Force Pressure	●	●	●	●	●	●	●	
SC259	Describes/Explains Fuels Fractional Distillation	●	●						
SC260	Describes/Explains Fuels Internal/External Combustion	●	●						
SC273	Describes/Explains Heat	●	●	●	●	●	●	●	
SC274	Describes/Explains Heat Conduction/Convection	●	●	●	●	●		●	
SC277	Describes/Explains Heat Expansion/Contraction	●	●	●			●	●	
SC278	Describes/Explains Heat Fusion/Vaporization	●		●				●	
SC280	Describes/Explains Heat Insulation	●	●		●		●	●	
SC282	Describes/Explains Heat Temperature	●	●	●	●		●	●	
SC329	Describes/Explains Light Opaque	●	●						

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
SC335	Describes/Explains Light Translucent/Transparent	●	●				●		
SC336	Describes/Explains Light Ultraviolet	●	●	●					
SC338	Describes/Explains Matter Density/Specific Gravity	●	●				●		
SC341	Describes/Explains Matter Phases/States	●	●					●	
SC349	Describes/Explains Motion Acceleration/Deceleration	●	●	●		●			
SC350	Describes/Explains Motion Action/Reaction	●	●	●	●	●			
SC351	Describes/Explains Motion Circular	●	●	●	●	●	●	●	
SC356	Describes/Explains Motion Vibrations/Waves	●	●	●	●	●	●	●	
SC395	Describes/Explains Solutions Solvent	●	●	●					
SC396	Describes/Explains Sound	●	●	●	●	●	●	●	
SC399	Describes/Explains Sound Carriers/Insulators	●	●	●	●	●	●	●	
SC402	Describes/Explains Sound Decibels/Intensity	●	●	●	●	●	●	●	
SC404	Describes/Explains Sound Frequency-Hertz	●	●	●	●	●	●	●	
SC406	Describes/Explains Sound Noise/Acoustics	●	●	●	●	●	●	●	
SC407	Describes/Explains Sound Overtones/Harmonics	●	●	●	●	●	●	●	
SC408	Describes/Explains Sound Pitch/Frequency	●	●	●	●	●	●	●	●
SC411	Describes/Explains Sound Resonance	●	●	●	●	●	●	●	
SC443	Describes/Explains Weather/Climate Relative Humidity						●	●	
SC445	Describes/Explains Work	●	●	●	●	●			
SC447	Describes/Explains Work Levers	●	●	●	●	●	●		
SC448	Describes/Explains Work Pulleys	●	●	●	●	●	●	●	

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
SC449	Identifies Acids/Bases						●	●	
SC467	Identifies Definitions Operational	●	●	●	●	●	●	●	
SC489	Measures Distance/Length	●	●	●	●	●	●	●	●
SC492	Measures Force	●	●	●	●	●	●	●	●
SC493	Measures Mass/Weight	●	●					●	
SC494	Measures Pressure	●	●	●	●	●	●	●	●
SC495	Measures Temperature Fahrenheit/Centigrade	●	●	●			●	●	
SC496	Measures Time	●	●	●		●	●	●	
SC497	Measures Volume Liquids/Solids	●	●	●			●	●	●
SC499	Uses Computers Information Processing	●	●	●	●	●	●	●	●
SC501	Uses Computers Problem Solving	●	●	●	●	●	●	●	
SC502	Measures Parameters Electrical	●	●	●	●	●	●	●	●
SC503	Describes/Explains Fluid System Hydraulics	●	●	●	●	●			
SC504	Describes/Explains Fluid System Pneumatics	●	●	●	●	●		●	
SC506	Describes/Explains Motion Friction	●	●	●	●	●	●	●	
SC507	Describes/Explains Motion Lubrication	●	●	●	●	●			
SC508	Describes/Explains Matter Metallurgy	●	●	●	●	●	●	●	
SC509	Describes/Explains Electricity Capacitance						●		
SC510	Describes/Explains Fluid System Dynamics	●	●	●		●		●	
SC511	Describes/Explains Matter Surface Process (Absorption/Adsorption)	●	●	●		●		●	
SC512	Describes/Explains Chemical Reactions Contamination	●	●	●	●	●	●	●	

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE EIGHT NATEF HEAVY/MEDIUM TRUCK TECHNICIAN SPECIALTY AREAS**

MEDIUM/HEAVY TRUCK TECHNICIAN COMPOSITE LIST		I. Gasoline Engines	II. Diesel Engines	III. Drive Train	IV. Suspension & Steering	V. Brakes	VI. Electrical/ Electronic Systems	VII. Heating and Air Conditioning	VIII. Preventive Maintenance Inspection
Ras Code	Description								
SC513	Describes/Explains Force Torque	●	●	●	●	●		●	●
SC514	Describes/Explains Electricity Semiconductor Devices						●	●	
SC515	Describes/Explains Work Simple Machines	●	●	●	●	●	●	●	
SC516	Describes/Explains Motion Rotational	●	●	●	●	●	●	●	
SC517	Describes/Explains Electricity-Generating Generators	●	●	●			●		
SC518	Describes/Explains Electricity Mechanical Transducers	●	●	●		●	●	●	
SC519	Describes/Explains Electricity Photocells							●	
SC520	Measures Flow Rate	●	●			●		●	
SC521	Describes/Explains Flow Rate	●	●			●		●	
SC522	Applies/Uses Ratio Proportion Mixtures	●	●	●		●		●	
SC528	Describes/Explains Adhesives/Sealants	●	●	●		●		●	
SC531	Describes/Explains Viscosity	●	●	●	●	●			

SCIENCE RELATED ACADEMIC SKILLS
for the
NATEF Medium/Heavy Truck Technician Task Lists

- SC007 Analyzes/Evaluates Environmental Issues
 - The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the truck technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a repair task.
- SC012 Analyzes/Evaluates Environmental Issues Waste Management
 - The technician evaluates the waste products resulting from a truck repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.
- SC041 Applies/Uses Laboratory Techniques Safety
 - The technician follows all safety regulations and applicable procedures while performing the task.
- SC042 Applies/Uses Maps/Charts/Tables/Graphs
 - The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for components and the appropriate repair/replacement procedure and/or part.
- SC044 Applies/Uses Scientific Methods
 - The technician develops a theory relative to the cause of the problem based on the information provided, then tests the hypothesis to determine the solution. Major steps include: ① identify the problem; ② gather information; ③ develop hypothesis; ④ take action; ⑤ check results.
- SC052 Converts Measurement Units English/Metric
 - The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.
- SC114 Describes/Explains Chemical Reactions
 - The technician can demonstrate an understanding of the chemical reaction that occurs in various substances used in various systems of the truck.
- SC121 Describes/Explains Chemical Reactions Inhibitors
 - The technician can explain the purpose of adding additives to various cooling, lubrication and fuel systems of the truck.
- SC177 Describes/Explains Electricity
 - The technician can demonstrate an understanding of and explain the properties of electricity that impact the lighting, engine management, and other electrical systems of a truck.
- SC178 Describes/Explains Batteries
 - The technician can demonstrate an understanding of the electrochemical reactions that occur in wet and dry cell batteries.
- SC180 Describes/Explains Conductors
 - The technician can explain the difference between electrical conductors and insulators.
- SC182 Describes/Explains Current AC-DC
 - The technician can explain the difference between direct and alternating current.

- SC184 Describes/Explains Electricity Ground
 - The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.
- SC186 Describes/Explains Electricity Parallel/Series Circuits
 - The technician can explain current flow and voltage in both parallel and series circuits.
- SC187 Describes/Explains Electricity Short Circuit
 - The technician can demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.
- SC194 Describes/Explains Electricity - Generating Motors
 - The technician can demonstrate an understanding of the role of the generator in maintaining battery and system voltage.
- SC197 Describes/Explains Electricity - Generating Transformers
 - The technician can explain the ignition coil transformer's role in generating the high voltage required to operate a component.
- SC198 Describes/Explains Electricity - Measurement
 - The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, and/or resistance.
- SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter
 - The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit.
- SC201 Describes/Explains Electricity - Measurement Fuse
 - The technician can demonstrate an understanding of and explain the role of a fuse or fusible link circuit breaker when used as a protective device in an electrical or electronic circuit.
- SC204 Describes/Explains Electricity - Measurement Resistance
 - The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.
- SC205 Describes/Explains Electricity - Measurement Voltage
 - The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.
- SC211 Describes/Explains Electrochemical Reactions
 - The technician can demonstrate an understanding of the electron transfer process that occurs in a truck battery.
- SC212 Describes/Explains Electrochemical Reactions Activity of Metals
 - The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.
- SC213 Describes/Explains Electrochemical Reactions Oxidation/Reduction
 - The technician can explain the effect of oxidation on electrical connections as well as various components of the truck cab, chassis, and trailer.

- SC214 Describes/Explains Electromagnetism
 - The technician can explain the relationship between electrical current in a conductor and magnetic field when produced in a coil such as the starter solenoid.
- SC215 Describes/Explains Electromagnetism Coil
 - The technician can explain how a coil can increase the battery voltage needed to fire a sparkplug.
- SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
 - The technician can explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.
- SC233 Describes/Explains Energy Kinetic/Potential
 - The technician can demonstrate an understanding of the kinetic and potential energy relationships that occur in valve systems, ignition systems, and other stored energy systems such as springs and fuels.
- SC249 Describes/Explains Energy Force, Balanced/Unbalanced
 - The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating assemblies of the vehicle.
- SC250 Describes/Explains Force Centrifugal/Centripetal
 - The technician can explain the relationship of centrifugal/centripetal force to the functioning or failure of a rotating component system within the truck.
- SC251 Describes/Explains Force Friction
 - The technician can demonstrate an understanding of friction and its effects on linear and rotational motion.
- SC255 Describes/Explains Force Pressure
 - The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.
- SC259 Describes/Explains Fuels Fractional Distillation
 - The technician can explain the ignition characteristics of gas and diesel fuels resulting from varying levels of fractional distillation (fuels with differing chemical make-ups).
- SC260 Describes/Explains Fuels Internal/External Combustion
 - The technician can demonstrate an understanding of how gas and diesel fuel characteristics affect combustion in a truck engine.
- SC273 Describes/Explains Heat
 - The technician can demonstrate an understanding of the effect of heat on truck systems.
- SC274 Describes/Explains Heat Conduction/Convection
 - The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various truck systems.
- SC277 Describes/Explains Heat Expansion/Contraction
 - The technician is able to demonstrate an understanding of the expansion and contraction of various system parts as a result of heat generated during the use and cooling of the system when not in operation.

- SC278 Describes/Explains Heat Fusion/Vaporization
 - The technician can demonstrate an understanding of the effect of how adding heat causes a change in state of matter, such as from a solid to a liquid to a gas.
- SC280 Describes/Explains Heat Insulation
 - The technician can explain the role of insulation in preventing unwanted heat transfer and in the deadening of sound.
- SC282 Describes/Explains Heat Temperature
 - The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.
- SC329 Describes/Explains Light Opaque
 -The technician can explain color and shades of color in fluids and lubricants based on how light hits it.
- SC335 Describes/Explains Light Translucent/Transparent
 - The technician can explain the difference between the principles of translucent as contrasted to transparent substances when dealing with fluids and liquids used in the engine and other components.
- SC336 Describes/Explains Light Ultraviolet
 - The technician can explain how ultraviolet rays can be used to find leaks in a system when florescent dyes are introduced into the system.
- SC338 Describes/Explains Matter Density/Specific Gravity
 - The technician can explain the need for a specific gravity test of battery electrolyte to determine charge.
- SC341 Describes/Explains Matter Phases/States
 - The technician can explain in detail the three states of matter.
- SC349 Describes/Explains Motion Acceleration/Deceleration
 - The technician can demonstrate an understanding of the process of a truck's acceleration and deceleration as a function of weight and available power.
- SC350 Describes/Explains Motion Action/Reaction
 - The technician can demonstrate an understanding of the reaction of fluid to the motion of a valve or piston.
- SC351 Describes/Explains Motion Circular
 - The technician can demonstrate an understanding of circular motion in a truck as it relates to the rotational components in the driveline.
- SC356 Describes/Explains Motion Vibrations/Waves
 - The technician is able to demonstrate an understanding of the cause and types of vibrations caused by out-of-balance or excessively worn systems.
- SC395 Describes/Explains Solutions Solvent
 - The technician understands the use and safety requirements of all solvents used in a truck environment.
- SC396 Describes/Explains Sound
 - The technician can demonstrate an understanding of the role sound plays in the cause of various noise problems in trucks.

- SC399 Describes/Explains Sound Carriers/Insulators
 - The technician can demonstrate an understanding of how sound generated in one place in the cab and/or engine can be carried to other parts of the cab, chassis, or engine through metal or other materials used in the vehicle.
- SC402 Describes/Explains Sound Decibels/Intensity
 - The technician can demonstrate an understanding of how sound intensity can be measured.
- SC404 Describes/Explains Sound Frequency-Hertz
 - The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating system.
- SC406 Describes/Explains Sound Noise/Acoustics
 - The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the truck and/or trailer.
- SC407 Describes/Explains Sound Overtones/Harmonics
 - The technician can explain that the presence of overtones may indicate changes in vibrations in various systems.
- SC408 Describes/Explains Sound Pitch/Frequency
 - The technician can explain the relationships of pitch to frequency.
- SC411 Describes/Explains Sound Resonance
 - The technician can demonstrate an understanding of what happens when an object resonates.
- SC443 Describes/Explains Weather/Climate Relative Humidity
 - The technician can demonstrate an understanding of and discuss relative humidity in terms of its effect on electrical heating and air conditioning systems of the truck.
- SC445 Describes/Explains Work
 - The technician can explain the relationship of engine torque to vehicle performance (horsepower).
- SC447 Describes/Explains Work Levers
 - The technician can explain how levers can be used to increase an applied force over distance.
- SC448 Describes/Explains Work Pulleys
 - The technician can explain how pulleys can be used to increase an applied force over distance.
- SC449 Identifies Acids/Bases
 - The technician can identify and explain the impact of acids and bases on the various components of the truck.
- SC467 Identifies Definitions Operational
 - The technician is able to identify and define terms that specifically relate to systems, diagnosis, service, and repair.
- SC489 Measures Distance/Length
 - The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.

- SC492 Measures Force
- The technician uses gauges such as a torque wrench to measure the force required to tighten connections according to the manufacturer's specifications.
- SC493 Measures Mass/Weight
- The technician uses a scale to measure component weight or to determine the volume, strength, and integrity of a component or part.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic systems and compares them to the manufacturer's specifications.
- SC495 Measures Temperature Fahrenheit/Centigrade
- The technician uses direct and indirect methods to measure system temperatures and then converts them to Fahrenheit or Centigrade as required.
- SC496 Measures Time
- The technician uses direct and indirect methods to measure cycle times for various components in the vehicle.
- SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of liquids in a system and then compares it to the manufacturer's specifications.
- SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.
- SC501 Uses Computers Problem Solving
- The technician uses computers, input devices, and on-board data feeds to solve problems more efficiently.
- SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, and continuity.
- SC503 Describes/Explains Fluid System Hydraulics
- The technician can explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location such as in the brake system or with selected tools and equipment used to realign the truck body or chassis.
- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic system, tools, and equipment.
- SC506 Describes/Explains Motion Friction
- The technician can explain the role that friction plays in the acceleration and deceleration of objects as well as the need for lubrication of adjacent parts in order to minimize friction.
- SC507 Describes/Explains Motion Lubrication
- The technician can discuss the role of lubrication in relation to the concept of friction.
- SC508 Describes/Explains Matter Metallurgy
- The technician can explain the criticality of metals with different hardness, depending on the function and location of the metal within the component or system of the truck.

- SC509 Describes/Explains Electricity Capacitance
 - The technician can demonstrate an understanding of the role of capacitance in timer circuits, such as RC timers or a MAP sensor wherein the changing manifold pressure causes two metal discs to act like a capacitor, sending a varying voltage to the electronic component control system.
- SC510 Describes/Explains Fluid System Dynamics
 - The technician can explain the dynamic control properties of a hydraulic system in terms of its impact on selected fluid driven systems in the vehicle.
- SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
 - The technician can explain the surface process that occurs on systems due to absorption of the various compounds.
- SC512 Describes/Explains Chemical Reactions Contamination
 - The technician can demonstrate an understanding of how a contaminated liquid can cause a chemical reaction which can result in the deterioration of a fluid or compound used in trucks.
- SC513 Describes/Explains Force Torque
 - The technician can demonstrate an understanding of how torque relates to force and angular acceleration.
- SC514 Describes/Explains Electricity Semiconductor Devices
 - The technician can demonstrate an understanding of the ability of semiconductor devices to rapidly modify engine operation parameters depending on multiple inputs from engine operational sensors.
- SC515 Describes/Explains Work Simple Machines
 - The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in a mechanical system.
- SC516 Describes/Explains Motion Rotational
 - The technician can explain how rotational motion can be changed to linear motion and why balance is important in these rotating systems.
- SC517 Describes/Explains Electricity-Generating Generators
 - The technician can demonstrate an understanding of the role generators play in the truck electrical system's operating characteristics.
- SC518 Describes/Explains Electricity Mechanical Transducers
 - The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the system's operating characteristics.
- SC519 Describes/Explains Electricity Photocells
 - The technician can demonstrate an understanding of the purpose of photocells and the measurement processes used to determine its output.
- SC520 Measures Flow Rate
 - The technician can use precision gauges or instruments to measure the flow rate of air in a truck component or system.
- SC521 Describes/Explains Flow Rate
 - The technician can demonstrate an understanding of how variances in flow rate can affect the functioning of a truck system.
- SC522 Applies/Uses Ratio Proportion Mixtures

- The technician can correctly use proportions and ratios in mixing fluids and other substances.

SC528 Describes/Explains Adhesives/Sealants

- The technician can demonstrate an understanding of how cohesive/adhesive forces aid in the use of various sealants.

SC531 Describes/Explains Viscosity

- The technician can explain fluid viscosity as a measurement and why it is important to the functioning of an engine or drive train component.

UNDULICATED RELATED ACADEMIC SKILLS

I. GASOLINE ENGINES

LANGUAGE ARTS:

- LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.
- LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the problem.
- LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g., customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the engine malfunction.
- LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for use in problem solving.
- LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.
- LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.
- LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various engine components and systems of the truck.
- LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g., shop manuals, references, and computer databases related to the truck.
- LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the engine problem.
- LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.
- LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the engine repair task or system of the truck under study.

- LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.
- LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.
- LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.
- LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.
- LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.
- LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.
- LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.
- LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.
- LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems associated with gasoline engines.
- LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships (problem solving or decision trees) presented in service manuals.
- LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for engine operation to identify out-of-tolerance systems/subsystems.
- LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.

- LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing engine malfunctions.
- LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information clearly and adequately when analyzing engine malfunctions.
- LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.
- LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.
- LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.
- LA247 Infers/Predicts Information-Written
- The technician makes inferences and predicts the solution to the problem from the information provided on the work order.
- LA256 Infers/Predicts Information-Written Outcomes/Solutions
- The technician makes inferences and solves problems from the information provided on the work order.
- LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.
- LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.
- LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for engine diagnosis and repair.
- LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.
- LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain truck tools and engine system equipment.
- LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and potential malfunctions.

MATH SKILLS (GASOLINE ENGINES)

- MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's engine repair specifications.
- MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's engine repair specifications.
- MA034 Computes Addition Whole Numbers
- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's engine repair specifications.
- MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's engine repair specifications.
- MA041 Computes Division Mentally
- The technician can mentally divide numbers to determine conformance with the manufacturer's engine repair specifications.
- MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's engine repair specifications.
- MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's engine repair specifications.
- MA066 Computes Multiplication Fractions
- The technician can multiply numbers that include fractions to determine conformance with the manufacturer's engine repair specifications.
- MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's engine repair specifications.
- MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's engine repair specifications.
- MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's engine repair specifications.
- MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's engine repair specifications.

- MA092 Computes Subtraction Whole Numbers
 - The technician can subtract whole numbers to determine differences for comparison with the manufacturer's engine repair specifications.
- MA097 Constructs Charts/Graphs/Tables
 - The technician can construct a chart, table, or graph that depicts a range of performance characteristics of various engine system operational conditions that can be used for comparisons.
- MA116 Converts Decimals/Fractions Ratios/Percents
 - The technician can convert test readings that are in decimal or fraction form to a ratio or percent form for comparison with the manufacturer's engine repair specifications.
- MA126 Converts Units English/Metric -- Feet/Meters, e.g.
 - The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturer for specifying the correct measurement or tolerance.
- MA128 Distinguishes Angles/Circles/Arcs
 - The technician must be highly skilled in determining if certain angles, circles, or arcs have the proper shape and relationship to each other.
- MA129 Distinguishes Congruence/Similarity Geometric Figures
 - The technician can distinguish whether or not the drive belt angle is within the manufacturer's specifications.
- MA131 Distinguishes Equal/Not Equal
 - The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.
- MA132 Distinguishes Estimate/Exact Value
 - The technician can distinguish the need to use an exact value versus an estimated value, depending upon the criticality of the engine sub-system being evaluated.
- MA133 Distinguishes Proportion/Congruence
 - The technician can distinguish the congruence of measured tolerances with those specified by the manufacturer.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
 - The technician estimates the anticipated performance outcome of a normally operating system as well as expected outcome of everyday occurrences such as the result of the engine electrical parameters being out of conformance with the manufacturer's specifications.
- MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
 - The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.
- MA153 Formulates/Verifies Angles
 - The technician can visually formulate a drive belt angle and verify its conformance to the manufacturer's specified angle.

MA161	Identifies	English Measures	Length/Volume/Weight
	- The technician can determine the degree of conformance to the manufacturer's engine specifications for length, volume and any other appropriate measurements in the English system.		
MA168	Identifies	Lines	Parallel/Perpendicular
	- The technician can use measurement devices to determine the parallelism or perpendicularity of engine component alignment.		
MA171	Identifies	Metric Measures	Length/Volume/Weight
	- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.		
MA172	Identifies	Missing/Irrelevant Data	Word Problems
	- The technician can discuss symptoms of problems with a customer or associate technician and identify any relevant missing data required to solve the problem.		
MA174	Interprets	Charts/Tables/Graphs	
	- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for engine parameters or clearances.		
MA176	Interprets	Symbols	<, >, =, e.g.
	- The technician interprets symbols to determine compliance with the manufacturer's specified clearances.		
MA177	Interprets	System of Numbers	Place Value
	- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements using micrometers, dial indicators, or other precision gauges.		
MA180	Measures	Direct	Angles
	- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.		
MA181	Measures	Direct	Distance
	- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.		
MA182	Measures	Direct	Temperature
	- The technician can use appropriate temperature measurement tools to determine the existing temperature of coolant or lubricant.		
MA183	Measures	Direct	Time
	- The technician needs to know that time is very critical to the proper timing of an engine.		
MA184	Measures	Direct	Volume
	- The technician can use various methods of measurement to determine the volume of selected substances.		
MA185	Measures	Direct	Weight
	- The technician uses scales to determine the weight of engine components during engine balancing operation.		
MA190	Measures	Metric	Distance
	- The technician can use metric measurement instruments to determine engine clearances using the metric system.		
MA191	Measures	Metric	Temperature

- The technician can use metric temperature measurement instruments to measure system temperature and determine conformance to engine manufacturer's specifications.

- MA192 Measures Metric Volume
- The technician can determine the volume of a system or vessel when the specifications are in liters.
- MA193 Measures Metric Weight
- The technician can use metric weighing devices to determine the conformance of a weight to metric tolerances.
- MA228 Solves Problems Fraction/Decimal/Ratio/Percent Direct/Indirect Variation
- The technician can analyze and solve problems requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.
- MA229 Solves Problems Generates Conclusions Deductive Reasoning
- The technician can identify the specific cause of the described problem by generating conclusions based on known symptoms related to the problem.
- MA230 Solves Problems Proportion
- The technician can solve problems that determine the proportion of variables of a solution and determine if that proportion is within the manufacturer's specifications.
- MA232 Solves Problems Proportion Volume
- The technician can solve problems that involve determining whether the proportion of the existing volume is within recommended tolerance when compared to the manufacturer's specifications.
- MA239 Understands Conditionals
- The technician understands that if the engine problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.
- MA242 Understands Definitions Standards
- The technician can use and conform to standards defined by each manufacturer for the engine sub-system being analyzed.
- MA244 Understands Geometric Figures Visual Perception
- The technician can visually perceive the geometric relationships of systems and sub-systems requiring alignment or verification.
- MA245 Understands Line/Angle Relationships
- The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications.
- MA258 Understands Statistics Probability
- The technician understands that problem symptoms can be statistically related to the probability of specific part or system malfunctioning.
- MA271 Determines Proper Operation
- The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's engine specifications.

- MA272 Computes Proper Operations
- The technician can accurately compute all arithmetic operations in the proper sequences to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA273 Computes Tolerances/Ranges Mentally
- When comparing the observed measurement to the manufacturer's engine specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.
- MA274 Computes Proper Operations Mentally
- The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.
- MA275 Identifies Temperatures Fahrenheit/Centigrade
- The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.
- MA276 Understands Tolerances Ranges
- The technician can choose the proper tool or instrument to determine if a specific system is within the tolerance or range specified by the manufacturer.

SCIENCE SKILLS (GASOLINE ENGINES)

- SC007 Analyzes/Evaluates Environmental Issues
- The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the truck technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of an engine repair task.
- SC012 Analyzes/Evaluates Environmental Issues Waste Management
- The technician evaluates the waste products resulting from a truck repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.
- SC041 Applies/Uses Laboratory Techniques Safety
- The technician follows all safety regulations and applicable procedures while performing the task.
- SC042 Applies/Uses Maps/Charts/Tables/Graphs
- The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for engine components and the appropriate repair/replacement procedure and/or part.
- SC044 Applies/Uses Scientific Methods
- The technician observes and gathers data from the symptoms and service manuals/bulletins to develop a hypothesis as to the cause of the engine problem. The technician tests the hypothesis to determine repairs to the engine assembly/sub-assembly.
- SC052 Converts Measurement Units English/Metric
- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.
- SC114 Describes/Explains Chemical Reactions
- The technician can demonstrate an understanding of the chemical reaction that occurs in various substances used in various systems of the truck engine.

- SC121 Describes/Explains Chemical Reactions Inhibitors
- The technician can explain the purpose of adding additives to various cooling, lubrication and fuel systems of the truck.
- SC177 Describes/Explains Electricity
- The technician can demonstrate an understanding of and explain the properties of electricity that impact engine management systems of a truck.
- SC180 Describes/Explains Conductors
- The technician can explain the difference between electrical conductors and insulators.
- SC182 Describes/Explains Current AC-DC
- The technician can explain the difference between direct and alternating current.
- SC184 Describes/Explains Electricity Ground
- The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.
- SC186 Describes/Explains Electricity Parallel/Series Circuits
- The technician can explain current flow and voltage in both parallel and series circuits.
- SC187 Describes/Explains Electricity Short Circuit
- The technician can demonstrate an understanding of the processes used to locate a short circuit in the engine's electrical/electronic system.
- SC194 Describes/Explains Electricity - Generating Motors
- The technician can demonstrate an understanding of the role of the generator in maintaining battery and system voltage.
- SC198 Describes/Explains Electricity - Measurement
- The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, and/or resistance.
- SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter
- The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit.
- SC201 Describes/Explains Electricity - Measurement Fuse
- The technician can demonstrate an understanding of and explain the role of a fuse or fusible link circuit breaker when used as a protective device in an electrical or electronic circuit.
- SC204 Describes/Explains Electricity - Measurement Resistance
- The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.
- SC205 Describes/Explains Electricity - Measurement Voltage
- The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.
- SC212 Describes/Explains Electrochemical Reactions Activity of Metals
- The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.
- SC213 Describes/Explains Electrochemical Reactions Oxidation/Reduction
- The technician can explain the effect of oxidation on the various electrical connections of the truck engine.

- SC214 Describes/Explains Electromagnetism
- The technician can explain the relationship between electrical current in a conductor and magnetic field when produced in a coil such as the starter solenoid.
- SC215 Describes/Explains Electromagnetism Coil
- The technician can explain how a coil can increase the battery voltage needed to fire a sparkplug.
- SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
- The technician can explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.
- SC233 Describes/Explains Energy Kinetic/Potential
- The technician can demonstrate an understanding of the kinetic and potential energy relationships that occur in valve systems, ignition systems, and other stored energy systems such as springs and fuels.
- SC249 Describes/Explains Energy Force, Balanced/Unbalanced
- The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating assemblies of the vehicle engine.
- SC250 Describes/Explains Force Centrifugal/Centripetal
- The technician can explain the relationship of centrifugal/centripetal force to the functioning or failure of a rotating component within the engine.
- SC251 Describes/Explains Force Friction
- The technician can demonstrate an understanding of friction and its effects on linear and rotational motion.
- SC255 Describes/Explains Force Pressure
- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.
- SC259 Describes/Explains Fuels Fractional Distillation
- The technician can explain the ignition characteristics of gasoline fuels resulting from varying levels of fractional distillation (fuels with differing chemical make-ups).
- SC260 Describes/Explains Fuels Internal/External Combustion
- The technician can demonstrate an understanding of how gasoline fuel characteristics affect combustion in a truck engine.
- SC273 Describes/Explains Heat
- The technician can demonstrate an understanding of the effect of heat on components of the truck engine.
- SC274 Describes/Explains Heat Conduction/Convection
- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various truck engines.
- SC277 Describes/Explains Heat Expansion/Contraction
- The technician is able to demonstrate an understanding of the expansion and contraction of various engine parts as a result of heat generated during use and the cooling of the engine when not in operation.
- SC278 Describes/Explains Heat Fusion/Vaporization
- The technician can demonstrate an understanding of the effect of how adding heat causes a change in state of matter, such as from a solid to a liquid to a gas.
- SC280 Describes/Explains Heat Insulation
- The technician can explain the role of insulation in preventing unwanted heat transfer.

- SC282 Describes/Explains Heat Temperature
- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.
- SC329 Describes/Explains Light Opaque
-The technician can explain color and shades of color in engine lubricants based on how light hits it.
- SC335 Describes/Explains Light Translucent/Transparent
- The technician can explain the difference between the principles of translucent as contrasted to transparent when dealing with fluids and liquids used in the engine and other components of the truck.
- SC336 Describes/Explains Light Ultraviolet
- The technician can explain how ultraviolet rays coupled with dyes can be used to find leaks in the engine.
- SC338 Describes/Explains Matter Density/Specific Gravity
- The technician can explain the need for a specific gravity test of battery electrolyte to determine charge.
- SC341 Describes/Explains Matter Phases/States
- The technician can explain in detail the three states of matter.
- SC349 Describes/Explains Motion Acceleration/Deceleration
- The technician can demonstrate an understanding of the process of a truck's acceleration and deceleration as a function of weight and available power.
- SC350 Describes/Explains Motion Action/Reaction
- The technician can demonstrate an understanding of the reaction of fluid to the motion of a valve or piston in the engine.
- SC351 Describes/Explains Motion Circular
- The technician can demonstrate an understanding of circular motion on engine parts in a truck.
- SC356 Describes/Explains Motion Vibrations/Waves
- The technician is able to demonstrate an understanding of the cause and types of vibrations caused by out-of-balance or excessively worn engine parts.
- SC395 Describes/Explains Solutions Solvent
- The technician understands the use and safety requirements of all solvents used in a truck repair environment.
- SC396 Describes/Explains Sound
- The technician can demonstrate an understanding of the role sound plays in the cause of various noise problems in the truck engine.
- SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the engine can be carried to other parts of the cab, chassis, or engine through metal or other materials used in the vehicle.
- SC402 Describes/Explains Sound Decibels/Intensity
- The technician can demonstrate an understanding of how sound intensity can be measured.
- SC404 Describes/Explains Sound Frequency-Hertz
- The technician is able to explain the relationship of the frequency of the sound to a specific engine part failure.

- SC406 Describes/Explains Sound Noise/Acoustics
 - The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the engine and engine compartment.
- SC407 Describes/Explains Sound Overtones/Harmonics
 - The technician can explain that the presence of overtones may indicate changes in vibrations in various systems and necessitate repair or replacement of engine parts.
- SC408 Describes/Explains Sound Pitch/Frequency
 - The technician can explain the relationships of pitch to frequency in diagnosing engine problems.
- SC411 Describes/Explains Sound Resonance
 - The technician can demonstrate an understanding of what happens when an object resonates.
- SC445 Describes/Explains Work
 - The technician can explain the relationship of engine torque to vehicle performance (horsepower).
- SC447 Describes/Explains Work Levers
 - The technician can explain how levers can be used to increase an applied force over distance.
- SC448 Describes/Explains Work Pulleys
 - The technician can explain how pulleys can be used to increase an applied force over distance.
- SC467 Identifies Definitions Operational
 - The technician is able to identify and define terms that specifically relate to systems, diagnosis, service, and repair.
- SC489 Measures Distance/Length
 - The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.
- SC492 Measures Force
 - The technician uses gauges such as a torque wrench to measure the force required to tighten engine connections according to the manufacturer's specifications.
- SC493 Measures Mass/Weight
 - The technician uses a scale to measure component weight during engine balancing operations.
- SC494 Measures Pressure
 - The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic systems and compares them to the manufacturer's specifications.
- SC495 Measures Temperature Fahrenheit/Centigrade
 - The technician uses direct and indirect methods to measure engine system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer.
- SC496 Measures Time
 - The technician uses direct and indirect methods to measure engine cycle times as well as labor time guides for selected tasks.
- SC497 Measures Volume Liquids/Solids
 - The technician uses direct and indirect methods to measure the volume of liquids for use in the engine.

- SC499 Uses Computers Information Processing
 - The technician uses computer databases for information retrieval and for input devices to process information for engine specifications, factory bulletins, warranty work, and other record-keeping purposes.
- SC501 Uses Computers Problem Solving
 - The technician uses computers, input devices, and on-board data feeds to identify engine parameters that are out of manufacturer's specifications.
- SC502 Measures Parameters Electrical
 - The technician uses precision electrical test equipment to measure current, voltage, resistance, and continuity.
- SC503 Describes/Explains Fluid System Hydraulics
 - The technician can explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote engine location.
- SC504 Describes/Explains Fluid System Pneumatics
 - The technician can demonstrate an understanding of the physical properties of an engine's pneumatic system, such as the intake or exhaust system.
- SC506 Describes/Explains Motion Friction
 - The technician can explain the role that friction plays in the acceleration and deceleration of objects as well as the need for lubrication of adjacent parts in order to minimize friction.
- SC507 Describes/Explains Motion Lubrication
 - The technician can discuss the role of lubrication in relation to the concept of friction in the engine.
- SC508 Describes/Explains Matter Metallurgy
 - The technician can explain the criticality of metals with different hardness, depending on the function and location of the metal within the engine.
- SC510 Describes/Explains Fluid System Dynamics
 - The technician can explain the dynamic properties of fluid flow through an engine's hydraulic systems (e.g. engine cooling and lubrication) as it relates to volume and flow rates.
- SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
 - The technician can explain the surface process that occurs on system seals due to absorption of the contained materials.
- SC512 Describes/Explains Chemical Reactions Contamination
 - The technician can demonstrate an understanding of how a contaminated liquid can cause a chemical reaction which can result in the deterioration of a fluid or compound used in the truck engine.
- SC513 Describes/Explains Force Torque
 - The technician can demonstrate an understanding of how torque relates to fastener tension during engine assembly.
- SC515 Describes/Explains Work Simple Machines
 - The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in the engine.
- SC516 Describes/Explains Motion Rotational
 - The technician can explain how engine rotational motion is changed to linear motion and why balance is important in rotating systems.

- SC517 Describes/Explains Electricity-Generating Generators
 - The technician can demonstrate an understanding of the role generators play in the engine's computer input devices.
- SC518 Describes/Explains Electricity Mechanical Transducers
 - The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the engine's operating characteristics.
- SC520 Measures Flow Rate
 - The technician can use precision gauges or instruments to measure the flow rate of air in an engine.
- SC521 Describes/Explains Flow Rate
 - The technician can demonstrate an understanding of how variances in flow rate in air flow sensors or cooling systems can affect engine performance.
- SC522 Applies/Uses Ratio Proportion Mixtures
 - The technician can correctly use proportions and ratios in mixing fluids and other substances.
- SC528 Describes/Explains Adhesives/Sealants
 - The technician can demonstrate an understanding of how cohesive/adhesive forces aid in the use of various sealants in the assembly of engine systems.
- SC531 Describes/Explains Viscosity
 - The technician can explain fluid viscosity as a measurement and why it is important to the functioning of an engine component.

UNDUPLICATED RELATED ACADEMIC SKILLS

II. DIESEL ENGINES

LANGUAGE ARTS:

- LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.
- LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the problem.
- LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g., customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the engine malfunction.
- LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for use in problem solving.
- LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.
- LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.
- LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various engine components and systems of the truck.
- LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g., shop manuals, references, and computer databases related to the truck.
- LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the engine problem.
- LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.
- LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the engine repair task or system of the truck under study.

- LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.
- LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.
- LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.
- LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.
- LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.
- LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.
- LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.
- LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.
- LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems associated with diesel engines.
- LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships (problem solving or decision trees) presented in service manuals.
- LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for engine operation to identify out-of-tolerance systems/sub-systems.
- LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.

- LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing an engine malfunction.
- LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information clearly and adequately when analyzing an engine malfunction.
- LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.
- LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.
- LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.
- LA247 Infers/Predicts Information-Written
- The technician makes inferences and predicts the solution to the problem from the information provided on the work order.
- LA256 Infers/Predicts Information-Written Outcomes/Solutions
- The technician makes inferences and solves problems from the information provided on the work order.
- LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.
- LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.
- LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for engine diagnosis and repair.
- LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.
- LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain truck tools and engine system equipment.
- LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and potential malfunctions.

MATH SKILLS (DEISEL ENGINES)

- MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's engine repair specifications.
- MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's engine repair specifications.
- MA034 Computes Addition Whole Numbers
- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's engine repair specifications.
- MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's engine repair specifications.
- MA041 Computes Division Mentally
- The technician can mentally divide numbers to determine conformance with the manufacturer's engine repair specifications.
- MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's engine repair specifications.
- MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's engine repair specifications.
- MA066 Computes Multiplication Fractions
- The technician can multiply numbers that include fractions to determine conformance with the manufacturer's engine repair specifications.
- MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's engine repair specifications.
- MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's engine repair specifications.
- MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's engine repair specifications.
- MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's engine repair specifications.

- MA092 Computes Subtraction Whole Numbers
 - The technician can subtract whole numbers to determine differences for comparison with the manufacturer's engine repair specifications.
- MA097 Constructs Charts/Graphs/Tables
 - The technician can construct a chart, table, or graph that depicts a range of performance characteristics of various engine system operational conditions that can be used for comparisons.
- MA116 Converts Decimals/Fractions Ratios/Percents
 - The technician can convert test readings that are in decimal or fraction form to a ratio or percent form for comparison with the manufacturer's engine repair specifications.
- MA126 Converts Units English/Metric -- Feet/Meters, e.g.
 - The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturer for specifying the correct measurement or tolerance.
- MA128 Distinguishes Angles/Circles/Arcs
 - The technician must be highly skilled in determining if certain angles, circles, or arcs have the proper shape and relationship to each other.
- MA129 Distinguishes Congruence/Similarity Geometric Figures
 - The technician can distinguish whether or not the drive belt angle between related parts is within the manufacturer's specifications.
- MA131 Distinguishes Equal/Not Equal
 - The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.
- MA132 Distinguishes Estimate/Exact Value
 - The technician can distinguish the need to use an exact value versus an estimated value, depending upon the criticality of the engine sub-system being evaluated.
- MA133 Distinguishes Proportion/Congruence
 - The technician can distinguish the congruence of measured tolerances with those specified by the manufacturer.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
 - The technician estimates the anticipated performance outcome of a normally operating system as well as expected outcome of everyday occurrences such as the result of the engine electrical parameters being out of conformance with the manufacturer's specifications.
- MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
 - The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.
- MA153 Formulates/Verifies Angles
 - The technician can visually formulate a drive belt angle and verify its conformance to the manufacturer's specified angle.
- MA161 Identifies English Measures Length/Volume/Weight
 - The technician can determine the degree of conformance to the manufacturer's engine specifications for length, volume and any other appropriate measurements in the English system.
- MA168 Identifies Lines Parallel/Perpendicular

- The technician can use measurement devices to determine the parallelism or perpendicularity of engine component alignment.

- MA171 Identifies Metric Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.
- MA172 Identifies Missing/Irrelevant Data Word Problems
- The technician can discuss symptoms of problems with a customer or associate technician and identify any relevant missing data required to solve the problem.
- MA174 Interprets Charts/Tables/Graphs
- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for engine parameters or clearances.
- MA176 Interprets Symbols $<$, $>$, $=$, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's specified clearances.
- MA177 Interprets System of Numbers Place Value
- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements using micrometers, dial indicators, or other precision gauges.
- MA180 Measures Direct Angles
- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.
- MA181 Measures Direct Distance
- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.
- MA182 Measures Direct Temperature
- The technician can use appropriate temperature measurement tools to determine the existing temperature of coolant or lubricant.
- MA183 Measures Direct Time
- The technician needs to know that time is very critical to the proper timing of an engine.
- MA184 Measures Direct Volume
- The technician can use various methods of measurement to determine the correct volume of selected substances.
- MA185 Measures Direct Weight
- The technician uses scales to determine the weight of engine components during engine balancing operation.
- MA190 Measures Metric Distance
- The technician can use metric measurement instruments to determine engine clearances using the metric system.
- MA191 Measures Metric Temperature
- The technician can use metric temperature measurement instruments to measure system temperature and determine conformance to engine manufacturer's specifications.
- MA192 Measures Metric Volume
- The technician can determine the volume of a system or vessel when the specifications are in liters.

- MA193 Measures Metric Weight
 - The technician can use metric weighing devices to determine the conformance of a weight to metric tolerances.
- MA228 Solves Problems Fraction/Decimal/Ratio/Percent Direct/Indirect Variation
 - The technician can analyze and solve problems requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.
- MA229 Solves Problems Generates Conclusions Deductive Reasoning
 - The technician can identify the specific cause of the described problem by generating conclusions based on known symptoms related to the problem.
- MA230 Solves Problems Proportion
 - The technician can solve problems that determine the proportion of variables of a solution and determine if that proportion is within the manufacturer's specifications.
- MA232 Solves Problems Proportion Volume
 - The technician can solve problems that involve determining whether the proportion of the existing volume is within recommended tolerance when compared to the manufacturer's specifications.
- MA239 Understands Conditionals
 - The technician understands that if the engine problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.
- MA242 Understands Definitions Standards
 - The technician can use and conform to standards defined by each manufacturer for the engine sub-system being analyzed.
- MA244 Understands Geometric Figures Visual Perception
 - The technician can visually perceive the geometric relationships of systems and sub-systems requiring alignment or verification.
- MA245 Understands Line/Angle Relationships
 - The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications.
- MA258 Understands Statistics Probability
 - The technician understands that problem symptoms can be statistically related to the probability of specific part or system malfunctioning.
- MA271 Determines Proper Operation
 - The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's engine specifications.
- MA272 Computes Proper Operations
 - The technician can accurately compute all arithmetic operations in the proper sequences to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA273 Computes Tolerances/Ranges Mentally
 - When comparing the observed measurement to the manufacturer's engine specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.

- MA274 Computes Proper Operations Mentally
 - The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.
- MA275 Identifies Temperatures Fahrenheit/Centigrade
 - The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.
- MA276 Understands Tolerances Ranges
 - The technician can choose the proper tool or instrument to determine if a specific system is within the tolerance or range specified by the manufacturer.

SCIENCE SKILLS (DIESEL ENGINES)

- SC007 Analyzes/Evaluates Environmental Issues
 - The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the truck technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of an engine repair task.
- SC012 Analyzes/Evaluates Environmental Issues Waste Management
 - The technician evaluates the waste products resulting from a truck repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.
- SC041 Applies/Uses Laboratory Techniques Safety
 - The technician follows all safety regulations and applicable procedures while performing the task.
- SC042 Applies/Uses Maps/Charts/Tables/Graphs
 - The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for engine components and the appropriate repair/replacement procedure and/or part.
- SC044 Applies/Uses Scientific Methods
 - The technician observes and gathers data from the symptoms and service manuals/bulletins to develop a hypothesis as to the cause of the engine problem. The technician tests the hypothesis to determine repairs to the engine assembly/sub-assembly.
- SC052 Converts Measurement Units English/Metric
 - The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.
- SC114 Describes/Explains Chemical Reactions
 - The technician can demonstrate an understanding of the chemical reaction that occurs in various substances used in various systems of the truck engine.
- SC121 Describes/Explains Chemical Reactions Inhibitors
 - The technician can explain the purpose of adding additives to various cooling, lubrication and fuel systems of the truck.
- SC177 Describes/Explains Electricity
 - The technician can demonstrate an understanding of and explain the properties of electricity that impact the lighting, engine management, and other electrical systems of a truck.
- SC180 Describes/Explains Conductors

- The technician can explain the difference between electrical conductors and insulators.
- SC182 Describes/Explains Current AC-DC
- The technician can explain the difference between direct and alternating current.
- SC184 Describes/Explains Electricity Ground
- The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.
- SC186 Describes/Explains Electricity Parallel/Series Circuits
- The technician can explain current flow and voltage in both parallel and series circuits.
- SC187 Describes/Explains Electricity Short Circuit
- The technician can demonstrate an understanding of the processes used to locate a short circuit in the engine's electrical/electronic system.
- SC194 Describes/Explains Electricity - Generating Motors
- The technician can demonstrate an understanding of the role of the generator in maintaining battery and system voltage.
- SC197 Describes/Explains Electricity - Generating Transformers
- The technician can explain the ignition coil transformer's role in generating the high voltage required to operate a component.
- SC198 Describes/Explains Electricity - Measurement
- The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, and/or resistance.
- SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter
- The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit.
- SC201 Describes/Explains Electricity - Measurement Fuse
- The technician can demonstrate an understanding of and explain the role of a fuse or fusible link circuit breaker when used as a protective device in an electrical or electronic circuit.
- SC204 Describes/Explains Electricity - Measurement Resistance
- The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.
- SC205 Describes/Explains Electricity - Measurement Voltage
- The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.
- SC212 Describes/Explains Electrochemical Reactions Activity of Metals
- The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.
- SC213 Describes/Explains Electrochemical Reactions Oxidation/Reduction
- The technician can explain the effect of oxidation on the various electrical connections of the truck engine.
- SC214 Describes/Explains Electromagnetism
- The technician can explain the relationship between electrical current in a conductor and magnetic field when produced in a coil such as the starter solenoid.
- SC215 Describes/Explains Electromagnetism Coil

- The technician can explain how a coil can increase the battery voltage needed to fire a sparkplug.
- SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
- The technician can explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.
- SC233 Describes/Explains Energy Kinetic/Potential
- The technician can demonstrate an understanding of the kinetic and potential energy relationships that occur in valve systems, ignition systems, and other stored energy systems such as springs and fuels.
- SC249 Describes/Explains Energy Force, Balanced/Unbalanced
- The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating assemblies of the truck engine.
- SC250 Describes/Explains Force Centrifugal/Centripetal
- The technician can explain the relationship of centrifugal/centripetal force to the functioning or failure of a rotating component system within the engine.
- SC251 Describes/Explains Force Friction
- The technician can demonstrate an understanding of friction and its effects on linear and rotational motion.
- SC255 Describes/Explains Force Pressure
- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.
- SC259 Describes/Explains Fuels Fractional Distillation
- The technician can explain the ignition characteristics of diesel fuels resulting from varying levels of fractional distillation (fuels with differing chemical make-ups).
- SC260 Describes/Explains Fuels Internal/External Combustion
- The technician can demonstrate an understanding of how diesel fuel characteristics affect combustion in a truck engine.
- SC273 Describes/Explains Heat
- The technician can demonstrate an understanding of the effect of heat on components of the truck engine.
- SC274 Describes/Explains Heat Conduction/Convection
- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various truck engines.
- SC277 Describes/Explains Heat Expansion/Contraction
- The technician is able to demonstrate an understanding of the expansion and contraction of various engine parts as a result of heat generated during use and the cooling of the engine when not in operation.
- SC280 Describes/Explains Heat Insulation
- The technician can explain the role of insulation in preventing unwanted heat transfer and in the deadening of sound.
- SC282 Describes/Explains Heat Temperature
- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.
- SC329 Describes/Explains Light Opaque
-The technician can explain color and shades of color in engine lubricants based on how light hits it.
- SC335 Describes/Explains Light Translucent/Transparent

- The technician can explain the difference between the principles of translucent as contrasted to transparent when dealing with fluids and liquids used in the engine and other components.
- SC336 Describes/Explains Light Ultraviolet
- The technician can explain how ultraviolet rays coupled with dyes can be used to find leaks in a system.
- SC338 Describes/Explains Matter Density/Specific Gravity
- The technician can explain the need for a specific gravity test of battery electrolyte to determine charge.
- SC341 Describes/Explains Matter Phases/States
- The technician can explain in detail the three states of matter.
- SC349 Describes/Explains Motion Acceleration/Deceleration
- The technician can demonstrate an understanding of the process of a truck's acceleration and deceleration as a function of weight and available power.
- SC350 Describes/Explains Motion Action/Reaction
- The technician can demonstrate an understanding of the reaction of fluid to the motion of a valve or piston.
- SC351 Describes/Explains Motion Circular
- The technician can demonstrate an understanding of circular motion in an engine part in a truck as it relates to such concepts as toe out on turns and tracking.
- SC356 Describes/Explains Motion Vibrations/Waves
- The technician is able to demonstrate an understanding of the cause and types of vibrations caused by out-of-balance or excessively worn engine parts.
- SC395 Describes/Explains Solutions Solvent
- The technician understands the use and safety requirements of all solvents used in a truck repair environment.
- SC396 Describes/Explains Sound
- The technician can demonstrate an understanding of the role sound plays in the cause of various noise problems in the truck engine.
- SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the engine can be carried to other parts of the cab, chassis, or engine through metal or other materials used in the vehicle.
- SC402 Describes/Explains Sound Decibels/Intensity
- The technician can demonstrate an understanding of how sound intensity can be measured.
- SC404 Describes/Explains Sound Frequency-Hertz
- The technician is able to explain the relationship of the frequency of the sound to a specific engine part failure.
- SC406 Describes/Explains Sound Noise/Acoustics
- The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the engine and engine compartment.
- SC407 Describes/Explains Sound Overtones/Harmonics
- The technician can explain that the presence of overtones may indicate changes in vibrations in various systems and necessitate repair or replacement of engine parts.
- SC408 Describes/Explains Sound Pitch/Frequency
- The technician can explain the relationships of pitch to frequency in diagnosing engine problems.

- SC411 Describes/Explains Sound Resonance
- The technician can demonstrate an understanding of what happens when an object resonates.
- SC445 Describes/Explains Work
- The technician can explain the relationship of engine torque to vehicle performance (horsepower).
- SC447 Describes/Explains Work Levers
- The technician can explain how levers can be used to increase an applied force over distance.
- SC448 Describes/Explains Work Pulleys
- The technician can explain how pulleys can be used to increase an applied force over distance.
- SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to systems, diagnosis, service, and repair.
- SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.
- SC492 Measures Force
- The technician uses gauges such as a torque wrench to measure the force required to tighten connections according to the manufacturer's specifications.
- SC493 Measures Mass/Weight
- The technician uses a scale to measure component weight during engine balancing operations.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic systems and compares them to the manufacturer's specifications.
- SC495 Measures Temperature Fahrenheit/Centigrade
- The technician uses direct and indirect methods to measure engine system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer.
- SC496 Measures Time
- The technician uses direct and indirect methods to measure engine cycle times as well as labor time guides for selected tasks.
- SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of liquids for use in the diesel engine.
- SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for engine specifications, factory bulletins, warranty work, and other record-keeping purposes.
- SC501 Uses Computers Problem Solving
- The technician uses computers, input devices, and on-board data feeds to identify engine parameters that are out-of-tolerance.

- SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, and continuity.
- SC503 Describes/Explains Fluid System Hydraulics
- The technician can explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote engine location.
- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties of an engine's pneumatic system such as the intake or exhaust system.
- SC506 Describes/Explains Motion Friction
- The technician can explain the role that friction plays in the acceleration and deceleration of objects as well as the need for lubrication of adjacent parts in order to minimize friction.
- SC507 Describes/Explains Motion Lubrication
- The technician can discuss the role of lubrication in relation to the concept of friction in the engine.
- SC508 Describes/Explains Matter Metallurgy
- The technician can explain the criticality of metals with different hardness, depending on the function and location of the metal within the engine.
- SC510 Describes/Explains Fluid System Dynamics
- The technician can explain the dynamic properties of a fluid flow through an engine's hydraulic systems (e.g. engine cooling and lubrication) as it relates to volume and flow rate.
- SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
- The technician can explain the surface process that occurs on system seals due to absorption of contained materials.
- SC512 Describes/Explains Chemical Reactions Contamination
- The technician can demonstrate an understanding of how a contaminated liquid can cause a chemical reaction which can result in the deterioration of a fluid or compound used in trucks.
- SC513 Describes/Explains Force Torque
- The technician can demonstrate an understanding of how torque relates to fastener tension during engine assembly.
- SC515 Describes/Explains Work Simple Machines
- The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in the engine.
- SC516 Describes/Explains Motion Rotational
- The technician can explain how engine rotational motion is changed to linear motion and why balance is important in rotating systems.
- SC517 Describes/Explains Electricity-Generating Generators
- The technician can demonstrate an understanding of the role generators play in the engine's computer input devices.
- SC518 Describes/Explains Electricity Mechanical Transducers
- The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the engine's operating characteristics.

- SC520 Measures Flow Rate
- The technician can use precision gauges or instruments to measure the flow rate of air in an engine.
- SC521 Describes/Explains Flow Rate
- The technician can demonstrate an understanding of how variances in flow rate in air flow sensors or cooling systems can affect engine performance.
- SC522 Applies/Uses Ratio Proportion Mixtures
- The technician can correctly use proportions and ratios in mixing fluids and other substances.
- SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how cohesive/adhesive forces aid in the use of various sealants in the assembly of engine systems.
- SC531 Describes/Explains Viscosity
- The technician can explain fluid viscosity as a measurement and why it is important to the functioning of an engine component.

UNDULICATED RELATED ACADEMIC SKILLS

III. DRIVE TRAIN

LANGUAGE ARTS:

- LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.
- LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the problem associated with the clutch or transmission.
- LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g., customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the drive train problem.
- LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for use in problem solving.
- LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.
- LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.
- LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various drive train components.
- LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g., shop manuals, references, and computer databases related to the truck.
- LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the drive train problem.
- LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.
- LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the drive train repair task or system.
- LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.

- LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.
- LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.
- LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.
- LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.
- LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.
- LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.
- LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.
- LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems associated with the drive train.
- LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a component or system.
- LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for the drive train component or system alignment.
- LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.
- LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a problem.

- LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information clearly and adequately when analyzing a problem.
- LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.
- LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.
- LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to driveshaft and universal joint noise and vibration problems based on discussions with customers, associates and supervisors.
- LA256 Infers/Predicts Information-Written Outcomes/Solutions
- The technician makes inferences and solves problems from the information provided on the work order.
- LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.
- LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.
- LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.
- LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.
- LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain truck tools and drive train system equipment.
- LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for drive train system operation, component specifications, and potential malfunctions.

MATH SKILLS (DRIVE TRAIN)

- MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.
- MA034 Computes Addition Whole Numbers

- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.
- MA039 Computes Division Decimals
 - The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.
- MA041 Computes Division Mentally
 - The technician can mentally divide numbers to determine conformance with the manufacturer's specifications.
- MA047 Computes Division Whole Numbers
 - The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA065 Computes Multiplication Decimals
 - The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA066 Computes Multiplication Fractions
 - The technician can multiply numbers that include fractions to determine conformance with the manufacturer's specifications.
- MA067 Computes Multiplication Mentally
 - The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA073 Computes Subtraction Whole Numbers
 - The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA084 Computes Subtraction Decimals
 - The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA086 Computes Subtraction Mentally
 - The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.
- MA092 Computes Subtraction Whole Numbers
 - The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA097 Constructs Charts/Graphs/Tables
 - The technician can construct a chart, table, or graph that depicts a range of performance characteristics of various drive train system operational conditions that can be used for comparisons.
- MA116 Converts Decimals/Fractions Ratios/Percents
 - The technician can convert test readings that are in decimal or fraction form to a ratio or percent form for comparison with the manufacturer's specifications.

- MA126 Converts Units English/Metric -- Feet/Meters, e.g.
 - The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturer for specifying the correct measurement or tolerance.
- MA128 Distinguishes Angles/Circles/Arcs
 - The technician must be highly skilled in determining if certain angles, circles, or arcs have the proper shape and relationship to each other.
- MA129 Distinguishes Congruence/Similarity Geometric Figures
 - The technician can distinguish whether or not the angle between related drive train parts are within the manufacturer's specifications.
- MA131 Distinguishes Equal/Not Equal
 - The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.
- MA132 Distinguishes Estimate/Exact Value
 - The technician can distinguish the need to use an exact value versus an estimated value, depending upon the drive train repair.
- MA133 Distinguishes Proportion/Congruence
 - The technician can distinguish the congruence of measured tolerances or gear ratios with those specified by the manufacturer.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
 - The technician estimates the anticipated performance outcome of a normally operating drive train system as well as expected outcome of everyday occurrences such as a slipping clutch or worn ring and pinion.
- MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
 - The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.
- MA153 Formulates/Verifies Angles
 - The technician can formulate a driveline angle and verify its conformance to the manufacturer's specified angle.
- MA161 Identifies English Measures Length/Volume/Weight
 - The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.
- MA168 Identifies Lines Parallel/Perpendicular
 - The technician can use measurement devices to determine the parallelism or perpendicularity of driveline components requiring geometric alignment principles.
- MA171 Identifies Metric Measures Length/Volume/Weight
 - The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.
- MA172 Identifies Missing/Irrelevant Data Word Problems
 - The technician can discuss symptoms of problems with the clutch or transmission with a customer or associate technician and identify any relevant missing data required to solve the problem.

- MA174 Interprets Charts/Tables/Graphs
 - The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for drive train operation.
- MA176 Interprets Symbols <, >, =, e.g.
 - The technician interprets symbols to determine compliance with the manufacturer's specifications.
- MA177 Interprets System of Numbers Place Value
 - The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements using micrometers, dial indicators, or other precision gauges.
- MA180 Measures Direct Angles
 - The technician can use angle measurement equipment and techniques to determine driveline angle variance from the manufacturer's specifications.
- MA181 Measures Direct Distance
 - The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.
- MA184 Measures Direct Volume
 - The technician can use various methods of measurement to determine the volume of the transmission fluid.
- MA185 Measures Direct Weight
 - The technician uses scales to determine whether the weight of a given component is in conformance with the manufacturer's specified weight.
- MA190 Measures Metric Distance
 - The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.
- MA191 Measures Metric Temperature
 - The technician can use metric temperature measurement instruments.
- MA192 Measures Metric Volume
 - The technician can determine the volume of a system or vessel when the specifications are in liters.
- MA193 Measures Metric Weight
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 - The technician understands that if the described transmission problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.
- MA242 Understands Definitions Standards
 - The technician can use and conform to standards defined by each manufacturer for the system being analyzed.
- MA244 Understands Geometric Figures Visual Perception
 - The technician can visually perceive the geometric relationships of systems and sub-systems requiring alignment or verification.
- MA245 Understands Line/Angle Relationships
 - The technician understands the necessity of verifying that the drive shaft and other drive train angles are within the manufacturer's specifications.
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 - The technician understands that problem symptoms can be statistically related to the probability of specific part or system malfunctioning.
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- MA272 Computes Proper Operations
 - The technician can accurately compute all arithmetic operations in the proper sequences to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA273 Computes Tolerances/Ranges Mentally
 - When comparing the observed measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.
- MA274 Computes Proper Operations Mentally
 - The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.
- MA275 Identifies Temperatures Fahrenheit/Centigrade
 - The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.
- MA276 Understands Tolerances Ranges
 - The technician can choose the proper tool or instrument to determine if a specific system is within the tolerance or range specified by the manufacturer.

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- SC007 Analyzes/Evaluates Environmental Issues
 - The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the truck technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a drive train repair task.
- SC012 Analyzes/Evaluates Environmental Issues Waste Management
 - The technician evaluates the waste products resulting from a truck repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.
- SC041 Applies/Uses Laboratory Techniques Safety
 - The technician follows all safety regulations and applicable procedures while performing the task.
- SC042 Applies/Uses Maps/Charts/Tables/Graphs
 - The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for drive train components and the appropriate repair/replacement procedure and/or part.
- SC044 Applies/Uses Scientific Methods
 - The technician develops a theory relative to the cause of the problem based on the information provided, then tests the hypothesis to determine the solution. Major steps include: ① identify the problem; ② gather information; ③ develop hypothesis; ④ take action; ⑤ check results.
- SC052 Converts Measurement Units English/Metric
 - The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.
- SC121 Describes/Explains Chemical Reactions Inhibitors
 - The technician can explain the purpose of adding additives to various coolants and lubricants used in the drive train of a medium or heavy truck.
- SC182 Describes/Explains Current AC-DC
 - The technician can explain the difference between direct and alternating current.
- SC184 Describes/Explains Electricity Ground
 - The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.
- SC186 Describes/Explains Electricity Parallel/Series Circuits
 - The technician can explain current flow and voltage in both parallel and series circuits.
- SC187 Describes/Explains Electricity Short Circuit
 - The technician can demonstrate an understanding of the processes used to locate a short circuit in the drive train electrical/electronic system.
- SC194 Describes/Explains Electricity - Generating Motors
 - The technician can demonstrate an understanding of the operation of the generator in the electronic speed sensors.
- SC198 Describes/Explains Electricity - Measurement
 - The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, and/or resistance.
- SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter

- The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit.
- SC201 Describes/Explains Electricity - Measurement Fuse
 - The technician can demonstrate an understanding of and explain the role of a fuse or fusible link circuit breaker when used as a protective device in an electrical or electronic circuit.
- SC204 Describes/Explains Electricity - Measurement Resistance
 - The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.
- SC205 Describes/Explains Electricity - Measurement Voltage
 - The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.
- SC214 Describes/Explains Electromagnetism
 - The technician can explain the relationship between electrical current in a conductor and magnetic field when produced in a coil.
- SC215 Describes/Explains Electromagnetism Coil
 - The technician can explain how a coil amplifies the signal generated in a vehicle speed sensor.
- SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
 - The technician can explain the effect of magnetic fields on unshielded electronic circuits.
- SC233 Describes/Explains Energy Kinetic/Potential
 - The technician can demonstrate an understanding of the kinetic and potential energy relationships that occur in the drive train.
- SC249 Describes/Explains Energy Force, Balanced/Unbalanced
 - The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating assemblies of the truck's drive train.
- SC250 Describes/Explains Force Centrifugal/Centripetal
 - The technician can explain the relationship of centrifugal/centripetal force to the functioning or failure of a rotating component system within the truck's drive train.
- SC251 Describes/Explains Force Friction
 - The technician can demonstrate an understanding of friction and its effects on linear and rotational motion.
- SC255 Describes/Explains Force Pressure
 - The technician can demonstrate an understanding of the relationship between pressure and force in the clutch's hydraulic actuation system.
- SC273 Describes/Explains Heat
 - The technician can demonstrate an understanding of the effect of heat on truck drive train systems.
- SC274 Describes/Explains Heat Conduction/Convection
 - The technician is able to explain the concept of heat transfer by conduction, radiation, and convection to the truck's drive train component failure.
- SC277 Describes/Explains Heat Expansion/Contraction
 - The technician is able to demonstrate an understanding of the expansion and contraction of various drive train system components as a result of heat generated during normal and abnormal use.

- SC278 Describes/Explains Heat Fusion/Vaporization
 - The technician can demonstrate an understanding of the effect of how adding heat causes a change in state of matter, such as from a solid to a liquid to a gas.
- SC282 Describes/Explains Heat Temperature
 - The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.
- SC336 Describes/Explains Light Ultraviolet
 - The technician can explain how ultraviolet rays and dyes can be used to find leaks in the drive train system.
- SC349 Describes/Explains Motion Acceleration/Deceleration
 - The technician can demonstrate an understanding of the process of a truck's acceleration and deceleration as a function of weight and available power in the drive train.
- SC350 Describes/Explains Motion Action/Reaction
 - The technician can demonstrate an understanding of the reaction of fluid to the motion of a piston or servo.
- SC351 Describes/Explains Motion Circular
 - The technician can demonstrate an understanding of circular motion in a truck part as it relates to the operation of the drive train.
- SC356 Describes/Explains Motion Vibrations/Waves
 - The technician is able to demonstrate an understanding of the cause of and types of vibrations caused by out-of-balance or excessively worn drive train components.
- SC395 Describes/Explains Solutions Solvent
 - The technician understands the use and safety requirements of all solvents used in a truck environment.
- SC396 Describes/Explains Sound
 - The technician can demonstrate an understanding of the role sound plays in the cause of various noise problems in the truck drive train.
- SC399 Describes/Explains Sound Carriers/Insulators
 - The technician can demonstrate an understanding of how sound generated in one place in the drive train can be carried to other parts of the cab, chassis, engine, or drive train through metal or other related materials.
- SC402 Describes/Explains Sound Decibels/Intensity
 - The technician can demonstrate an understanding of how sound intensity can be measured.
- SC404 Describes/Explains Sound Frequency-Hertz
 - The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating drive train system.
- SC406 Describes/Explains Sound Noise/Acoustics
 - The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the truck and/or trailer.
- SC407 Describes/Explains Sound Overtones/Harmonics
 - The technician can explain that the presence of overtones may indicate changes in vibrations in various systems.

- SC408 Describes/Explains Sound Pitch/Frequency
- The technician can explain the relationships of pitch to frequency.
- SC411 Describes/Explains Sound Resonance
- The technician can demonstrate an understanding of what happens when an object resonates.
- SC445 Describes/Explains Work
- The technician can explain the relationship of engine torque to vehicle drive train performance.
- SC447 Describes/Explains Work Levers
- The technician can explain how levers can be used to increase an applied force over distance.
- SC448 Describes/Explains Work Pulleys
- The technician can explain how pulleys can be used to increase an applied force over distance.
- SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to drive train systems, diagnosis, service, and repair.
- SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if dimensions or adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.
- SC492 Measures Force
- The technician uses gauges such as a torque wrench to measure the force or tension required to tighten drive train connections according to the manufacturer's specifications.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic systems of the drive train and compares them to the manufacturer's specifications.
- SC495 Measures Temperature Fahrenheit/Centigrade
- The technician uses direct and indirect methods to measure system temperatures and then converts them to Fahrenheit or Centigrade.
- SC496 Measures Time
- The technician uses direct and indirect methods to measure cycle times for various components in the vehicle.
- SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of liquids in the drive train and compare to manufacturer's specifications.
- SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.
- SC501 Uses Computers Problem Solving
- The technician uses computers, input devices, and on-board data feeds to solve drive train problems.
- SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, and continuity.

- SC503 Describes/Explains Fluid System Hydraulics
- The technician can explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location such as in the clutch's actuation system.
- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of how pneumatic systems are used to control/assist shifting of gears.
- SC506 Describes/Explains Motion Friction
- The technician can explain the role that friction plays in the acceleration and deceleration of objects as well as the need for lubrication of adjacent drive train parts in order to minimize friction.
- SC507 Describes/Explains Motion Lubrication
- The technician can discuss the role of lubrication in relation to the concept of friction in the drive train.
- SC508 Describes/Explains Matter Metallurgy
- The technician can explain the criticality of metals with different hardness, depending on the function and location of the metal within the component or system of the truck's drive train.
- SC510 Describes/Explains Fluid System Dynamics
- The technician can explain the dynamic fluid control properties of a hydraulic system in terms of its impact on volume and flow rates.
- SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
- The technician can explain the surface process that occurs on drive train and axle seals due to absorption of the contained materials.
- SC512 Describes/Explains Chemical Reactions Contamination
- The technician can demonstrate an understanding of how a contaminated liquid can cause a chemical reaction that affects the truck's drive train performance.
- SC513 Describes/Explains Force Torque
- The technician can demonstrate an understanding of how torque transmitted to the drive train and axle relates to the force that moves the vehicle.
- SC515 Describes/Explains Work Simple Machines
- The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in a mechanical system.
- SC516 Describes/Explains Motion Rotational
- The technician can explain how rotational motion can be changed to linear motion and why balance is important in these rotating systems.
- SC517 Describes/Explains Electricity-Generating Generators
- The technician can demonstrate an understanding of the operation of the generator as a part of the vehicle speed sensor.
- SC518 Describes/Explains Electricity Mechanical Transducers
- The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the system's operating characteristics.
- SC522 Applies/Uses Ratio Proportion Mixtures
- The technician can correctly use proportions and ratios.
- SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how cohesive/adhesive forces aid in the use of various sealants.

SC531 Describes/Explains Viscosity

- The technician can explain fluid viscosity as a measurement and why it is important to the functioning of a drive train component.

UNDULICATED RELATED ACADEMIC SKILLS

IV. SUSPENSION & STEERING

LANGUAGE ARTS:

- LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.
- LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the suspension and steering problem.
- LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g., customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the suspension and steering problem.
- LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for use in problem solving.
- LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.
- LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.
- LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various suspension and steering components and systems of the truck.
- LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g., shop manuals, references, and computer databases related to the truck suspension and steering system.
- LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the suspension and steering problem.
- LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.
- LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the suspension and steering repair task of the truck.

- LA036 Attends Nonverbal Cues
-The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve steering system problems.
- LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.
- LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.
- LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.
- LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.
- LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.
- LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.
- LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.
- LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.
- LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a suspension and steering component or system.
- LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for the suspension and steering component or system alignment.
- LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.
- LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a wandering or hard steering problem.

- LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information clearly and adequately when analyzing a problem.
- LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.
- LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.
- LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.
- LA247 Infers/Predicts Information-Written
- The technician makes inferences and predicts the solution to the problem from the information provided on the work order.
- LA256 Infers/Predicts Information-Written Outcomes/Solutions
- The technician makes inferences and solves problems from the information provided on the work order.
- LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.
- LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.
- LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for suspension and steering diagnosis and repair.
- LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.
- LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain truck tools and suspension and steering system equipment.
- LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for suspension and steering system operation, component specifications, and potential malfunctions.

MATH SKILLS (SUSPENSION & STEERING)

- MA001 Calculates/Evaluates Algebraic Expressions
- The technician can use Ohm's Law to determine electrical circuit parameters that are out-of-tolerance.
- MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's

specifications.

- MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.
- MA034 Computes Addition Whole Numbers
- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.
- MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.
- MA041 Computes Division Mentally
- The technician can mentally divide numbers to determine conformance with the manufacturer's specifications.
- MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA066 Computes Multiplication Fractions
- The technician can multiply numbers that include fractions to determine conformance with the manufacturer's specifications.
- MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.
- MA092 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

- MA116 Converts Decimals/Fractions Ratios/Percents
 - The technician can convert test readings that are in decimal or fraction form to a ratio or percent form for comparison with the manufacturer's specifications.
- MA126 Converts Units English/Metric -- Feet/Meters, e.g.
 - The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturer for specifying the correct suspension and steering measurement or tolerance.
- MA128 Distinguishes Angles/Circles/Arcs
 - The technician must be highly skilled in determining if certain angles, circles, or arcs have the proper shape and relationship to each other.
- MA129 Distinguishes Congruence/Similarity Geometric Figures
 - The technician can distinguish whether or not the angle between related parts (e.g. suspension components) is within the manufacturer's specifications.
- MA131 Distinguishes Equal/Not Equal
 - The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.
- MA132 Distinguishes Estimate/Exact Value
 - The technician can distinguish the need to use an exact value versus an estimated value, depending upon the system malfunction.
- MA133 Distinguishes Proportion/Congruence
 - The technician can distinguish the congruence of measured tolerances with those specified by the manufacturer for suspension and steering systems.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
 - The technician estimates the anticipated performance outcome of a normally operating system as well as expected outcome of everyday occurrences such as wheels out of balance or alignment.
- MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
 - The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.
- MA153 Formulates/Verifies Angles
 - The technician can visually formulate an angle, (e.g. suspension system or component alignment) and verify its conformance to the manufacturer's specified angle.
- MA161 Identifies English Measures Length/Volume/Weight
 - The technician can determine the degree of conformance to the manufacturer's specifications for suspension and steering component length and any other appropriate measurements in the English system.
- MA168 Identifies Lines Parallel/Perpendicular
 - The technician can use measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle dimensions requiring geometric alignment principles.
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- MA171 Identifies Metric Measures Length/Volume/Weight
 - The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.

- MA172 Identifies Missing/Irrelevant Data Word Problems
 - The technician can discuss symptoms of problems with a customer or associate technician and identify any relevant missing data required to solve the problem.
- MA174 Interprets Charts/Tables/Graphs
 - The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.
- MA176 Interprets Symbols $<$, $>$, $=$, e.g.
 - The technician interprets symbols to determine compliance with the manufacturer's specifications.
- MA177 Interprets System of Numbers Place Value
 - The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements using micrometers, dial indicators, or other precision gauges.
- MA180 Measures Direct Angles
 - The technician can use angle measurement equipment and techniques to determine any suspension and steering angle measurement variance from the manufacturer's specifications.
- MA181 Measures Direct Distance
 - The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.
- MA184 Measures Direct Volume
 - The technician can use various methods of measurement to determine the volume in the power steering system.
- MA185 Measures Direct Weight
 - The technician uses scales to determine whether the weight of a given component is in conformance with the manufacturer's specified weight.
- MA190 Measures Metric Distance
 - The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.
- MA228 Solves Problems Fraction/Decimal/Ratio/Percent Direct/Indirect Variation
 - The technician can analyze and solve problems requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.
- MA229 Solves Problems Generates Conclusions Deductive Reasoning
 - The technician can identify the specific cause of the described problem by generating conclusions based on known symptoms related to the problem.
- MA230 Solves Problems Proportion
 - The technician can solve problems that determine the proportion of variables of a solution and determine if that proportion is within the manufacturer's specifications.
- MA232 Solves Problems Proportion Volume
 - The technician can solve problems that involve determining whether the proportion of the existing volume is within recommended tolerance when compared to the manufacturer's specifications.
- MA239 Understands Conditionals
 - The technician understands that if the described steering problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.

- MA242 Understands Definitions Standards
 - The technician can use and conform to standards defined by each manufacturer for the suspension and steering system being analyzed.
- MA244 Understands Geometric Figures Visual Perception
 - The technician can visually perceive the geometric relationships of suspension and steering systems and sub-systems requiring alignment or verification.
- MA245 Understands Line/Angle Relationships
 - The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications when diagnosing the alignment of a cab, trailer, or steering and suspension systems.
- MA271 Determines Proper Operation
 - The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA272 Computes Proper Operations
 - The technician can accurately compute all arithmetic operations in the proper sequences to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA273 Computes Tolerances/Ranges Mentally
 - When comparing the observed suspension and steering measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.
- MA274 Computes Proper Operations Mentally
 - The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.
- MA276 Understands Tolerances Ranges
 - The technician can choose the proper tool or instrument to determine if a specific system is within the tolerance or range specified by the manufacturer.

SCIENCE SKILLS (SUSPENSION & STEERING)

- SC007 Analyzes/Evaluates Environmental Issues
 - The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the truck technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a suspension and steering repair task.
- SC012 Analyzes/Evaluates Environmental Issues Waste Management
 - The technician evaluates the waste products resulting from a truck repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.
- SC041 Applies/Uses Laboratory Techniques Safety
 - The technician follows all safety regulations and applicable procedures while performing the task.
- SC042 Applies/Uses Maps/Charts/Tables/Graphs
 - The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for suspension and steering components and the appropriate repair/replacement procedure and/or part.
- SC044 Applies/Uses Scientific Methods
 - The technician uses observations and gathers information to identify symptoms to develop a theory

regarding the cause of the steering and suspension problem. The technician then tests the hypothesis through measurement and other precise methods to determine the solution to the problem.

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|-------|--|---------------------------|----------------------------|
| SC052 | Converts | Measurement Units | English/Metric |
| | - The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system. | | |
| SC121 | Describes/Explains | Chemical Reactions | Inhibitors |
| | - The technician can explain the purpose of having additives in lubricants in the steering system. | | |
| SC182 | Describes/Explains | Current | AC-DC |
| | - The technician can explain the difference between direct and alternating current. | | |
| SC184 | Describes/Explains | Electricity | Ground |
| | - The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded. | | |
| SC186 | Describes/Explains | Electricity | Parallel/Series Circuits |
| | - The technician can explain current flow and voltage in both parallel and series circuits. | | |
| SC187 | Describes/Explains | Electricity | Short Circuit |
| | - The technician can demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system related to the suspension and steering system. | | |
| SC198 | Describes/Explains | Electricity - Measurement | |
| | - The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, and/or resistance. | | |
| SC199 | Describes/Explains | Electricity - Measurement | Ammeter/Voltmeter |
| | - The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit. | | |
| SC212 | Describes/Explains | Electrochemical Reactions | Activity of Metals |
| | - The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions. | | |
| SC214 | Describes/Explains | Electromagnetism | |
| | - The technician can explain the function/operation of an electronic vehicle speed sensor. | | |
| SC233 | Describes/Explains | Energy | Kinetic/Potential |
| | - The technician can describe a spring rebound rate in terms of kinetic and potential energy. | | |
| SC249 | Describes/Explains | Energy | Force, Balanced/Unbalanced |
| | - The technician can demonstrate an understanding of the impact of balanced and unbalanced forces on linear or rotating assemblies of the truck's suspension and steering system. | | |
| SC250 | Describes/Explains | Force | Centrifugal/Centripetal |
| | - The technician can explain the relationship of centrifugal/centripetal force to the functioning or failure of a rotating component system within the truck's steering system. | | |
| SC251 | Describes/Explains | Force | Friction |
| | - The technician can demonstrate an understanding of friction and its effects on linear and rotational motion on the truck's suspension and steering systems. | | |
| SC255 | Describes/Explains | Force | Pressure |
| | - The technician can demonstrate an understanding of the concept of pressure in relation to the concept of | | |

force.

- SC273 Describes/Explains Heat
- The technician can demonstrate an understanding of the effect of heat on truck systems.
- SC274 Describes/Explains Heat Conduction/Convection
- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various truck systems.
- SC280 Describes/Explains Heat Insulation
- The technician can explain the role of insulation in maintaining stable temperatures and in the deadening of sound.
- SC282 Describes/Explains Heat Temperature
- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.
- SC350 Describes/Explains Motion Action/Reaction
- The technician can demonstrate an understanding of the reaction of fluid to the motion of a valve or piston in the suspension and steering system.
- SC351 Describes/Explains Motion Circular
- The technician can demonstrate an understanding of circular motion in a truck part as it relates to the operation of the steering and suspension system.
- SC356 Describes/Explains Motion Vibrations/Waves
- The technician is able to demonstrate an understanding of the cause and types of vibrations caused by out-of-balance or excessively worn suspension and steering components.
- SC396 Describes/Explains Sound
- The technician can demonstrate an understanding of the role sound plays in diagnosing the cause of various problems in the truck's suspension and steering system.
- SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the suspension and steering system can be carried to other parts of the vehicle through metal and other related materials.
- SC402 Describes/Explains Sound Decibels/Intensity
- The technician can demonstrate an understanding of how sound intensity can be measured.
- SC404 Describes/Explains Sound Frequency-Hertz
- The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating suspension and steering system.
- SC406 Describes/Explains Sound Noise/Acoustics
- The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the truck and/or trailer.
- SC407 Describes/Explains Sound Overtones/Harmonics
- The technician can explain that the presence of overtones may indicate multiple problems in the suspension and steering system.

- SC408 Describes/Explains Sound Pitch/Frequency
- The technician can explain the relationships of pitch to frequency.
- SC411 Describes/Explains Sound Resonance
- The technician can demonstrate an understanding of what happens when an object resonates.
- SC445 Describes/Explains Work
- The technician can explain the relationship of engine torque to suspension and steering component performance.
- SC447 Describes/Explains Work Levers
- The technician can explain how levers can be used to increase an applied force over distance in the suspension and steering system.
- SC448 Describes/Explains Work Pulleys
- The technician can explain how pulleys can be used to increase an applied force over distance.
- SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to suspension and steering systems, diagnosis, service, and repair.
- SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.
- SC492 Measures Force
- The technician uses a torque wrench to measure the force required to tighten suspension and steering components according to the manufacturer's specifications.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine tire pressures and compares them to the manufacturer's specifications.
- SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.
- SC501 Uses Computers Problem Solving
- The technician uses computer based equipment to solve problems with the suspension and steering system more efficiently.
- SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure electrical/electronic circuits on automatic level control systems.
- SC503 Describes/Explains Fluid System Hydraulics
- The technician can describe how a power steering pump pressure can be transmitted via fluids to provide decreased steering effort.
- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic system, tools, and equipment.
- SC506 Describes/Explains Motion Friction
- The technician can explain the role that friction plays in the acceleration and deceleration of objects as well as the need for lubrication of adjacent parts in the suspension and steering system to minimize friction.

- SC507 Describes/Explains Motion Lubrication
 - The technician can discuss the role of lubrication in relation to the concept of friction.
- SC508 Describes/Explains Matter Metallurgy
 - The technician can explain the criticality of metals with different hardness, depending on the function and location of the metal within the suspension and steering component or system of the truck.
- SC512 Describes/Explains Chemical Reactions Contamination
 - The technician can describe the deterioration in steering system performance due to chemical reaction that occurs in a liquid that becomes contaminated.
- SC513 Describes/Explains Force Torque
 - The technician can describe how torque relates to the rotational force required to tighten fasteners to manufacturer's specifications.
- SC515 Describes/Explains Work Simple Machines
 - The technician can describe how suspension and steering geometry related to pulleys and levers are used to multiply force or transfer directions of force in a mechanical system.
- SC516 Describes/Explains Motion Rotational
 - The technician can explain how rotational motion can be changed to linear motion and why balance is important in these rotating systems.
- SC531 Describes/Explains Viscosity
 - The technician can explain fluid viscosity as a measurement and why it is important to the functioning of a power steering system.

UNDULICATED RELATED ACADEMIC SKILLS

V. BRAKES

LANGUAGE ARTS:

- LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication when collecting diagnostic information about the braking system.
- LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the braking system problem.
- LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g., customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the problem with the brakes.
- LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for use in solving brake problems.
- LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.
- LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.
- LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various brake system components.
- LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's braking system publications, e.g., shop manuals, references, and computer databases.
- LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of braking system problem diagnosis processes to determine the specific cause(s) of the problem.
- LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar brake system malfunction under review, then study the applicable information with the intensity necessary for the situation.
- LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the braking system repair.
- LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve braking system problems.

- LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve braking system problems.
- LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the braking system problem analysis and solution process.
- LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.
- LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.
- LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.
- LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.
- LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding braking system problem symptoms and potential solutions.
- LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.
- LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses braking system cause and effect relationships presented in service manual problem solving trees to diagnose problems in a component or system.
- LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for the brake system operation or identify out-of-tolerance systems/sub-systems.
- LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific braking system problem.
- LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a braking system problem.
- LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written braking system information when analyzing a problem.

- LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.
- LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.
- LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to braking system problems based on discussions with customers, associates and supervisors.
- LA256 Infers/Predicts Information-Written Outcomes/Solutions
- The technician makes inferences and solves braking system problems from the information provided on the work order.
- LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the braking system problem from associates and supervisors.
- LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.
- LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair of the brake system.
- LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain brake system information.
- LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain truck tools and equipment.
- LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for operation and potential malfunctions of the braking system.

MATH SKILLS (BRAKES)

- MA001 Calculates/Evaluates Algebraic Expressions
- The technician can use Ohm's Law to determine electrical circuit parameters that are out-of-tolerance.
- MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's braking system specifications.
- MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's braking system specifications.

- MA034 Computes Addition Whole Numbers
-The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.
- MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's braking system specifications.
- MA041 Computes Division Mentally
- The technician can mentally divide numbers to determine conformance with the manufacturer's braking system specifications.
- MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's braking system specifications.
- MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's braking system specifications.
- MA066 Computes Multiplication Fractions
- The technician can multiply numbers that include fractions to determine conformance with the manufacturer's braking system specifications.
- MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's braking system specifications.
- MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's braking system specifications.
- MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's braking system specifications.
- MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's braking system specifications.
- MA092 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA126 Converts Units English/Metric -- Feet/Meters, e.g.
- The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturer for specifying the correct braking system measurement or tolerance.
- MA129 Distinguishes Congruence/Similarity Geometric Figures
- The technician can distinguish whether or not the angle between related parts is within the manufacturer's specifications.

- MA131 Distinguishes Equal/Not Equal
- The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.
- MA132 Distinguishes Estimate/Exact Value
- The technician can distinguish the need to use an exact value versus an estimated value, depending upon the braking system service procedures.
- MA133 Distinguishes Proportion/Congruence
- The technician can distinguish the congruence of measured braking system tolerances with those specified by the manufacturer.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
- The technician estimates the anticipated performance outcome of a normally operating braking system as well as expected outcome of everyday occurrences such as worn pads or shoes.
- MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
- The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.
- MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle, and verify its conformance to the manufacturer's specified angle for the braking system.
- MA161 Identifies English Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.
- MA168 Identifies Lines Parallel/Perpendicular
- The technician can use measurement devices to determine the parallelism or perpendicularity of braking system components requiring geometric alignment principles.
- MA171 Identifies Metric Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.
- MA172 Identifies Missing/Irrelevant Data Word Problems
- The technician can discuss symptoms of problems with a customer or associate technician and identify any relevant missing data required to solve the problem.
- MA174 Interprets Charts/Tables/Graphs
- The technician can interpret charts, tables, or graphs to determine the manufacturer's braking system specifications for a given service procedure.
- MA176 Interprets Symbols $<$, $>$, $=$, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's braking system specified clearances.
- MA177 Interprets System of Numbers Place Value
- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements using micrometers, dial indicators, or other precision gauges.

- MA180 Measures Direct Angles
- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.
- MA181 Measures Direct Distance
-The technician can measure distance using a variety of devices to determine conformance to the manufacturer's braking system specifications.
- MA183 Measures Direct Time
- The technician can measure air system build-up time and compare the measurement with manufacturer's specifications.
- MA190 Measures Metric Distance
- The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.
- MA192 Measures Metric Volume
- The technician can determine the volume of a system or vessel when the specifications are in liters.
- MA228 Solves Problems Fraction/Decimal/Ratio/Percent Direct/Indirect Variation
- The technician can analyze and solve problems with the braking system requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.
- MA229 Solves Problems Generates Conclusions Deductive Reasoning
- The technician can identify the specific cause of the described braking system problem by generating conclusions based on symptoms related to the problem.
- MA230 Solves Problems Proportion
- The technician can solve problems that determine the proportion of variables of a solution and determine if that proportion is within the manufacturer's specifications.
- MA232 Solves Problems Proportion Volume
- The technician can solve problems that involve determining whether the proportion of the existing volume is within recommended tolerance when compared to the manufacturer's braking system specifications.
- MA239 Understands Conditionals
- The technician understands that if the described braking problem has certain conditions (symptoms), then there are a limited number of solutions to the problem.
- MA242 Understands Definitions Standards
- The technician can use and conform to standards defined by each manufacturer for the brake system being analyzed.
- MA244 Understands Geometric Figures Visual Perception
- The technician can visually perceive the geometric relationships of braking systems and sub-systems requiring alignment or verification.
- MA245 Understands Line/Angle Relationships
- The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications.
- MA271 Determines Proper Operation
- The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing braking system measurements to the manufacturer's specifications.

- MA272 Computes Operations
 - The technician can accurately compute all arithmetic operations in the proper sequences to arrive at a solution when comparing braking system measurements to the manufacturer's specifications.
- MA273 Computes Tolerances/Ranges Mentally
 - When comparing the observed measurement to the manufacturer's brake system specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.
- MA274 Computes Proper Operations Mentally
 - The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.
- MA275 Identifies Temperatures Fahrenheit/Centigrade
 - The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.
- MA276 Understands Tolerances Ranges
 - The technician can choose the proper tool or instrument to determine if a specific system is within the tolerance or range specified by the manufacturer.

SCIENCE SKILLS (BRAKES)

- SC007 Analyzes/Evaluates Environmental Issues
 - The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the truck technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a brake system repair task.
- SC012 Analyzes/Evaluates Environmental Issues Waste Management
 - The technician evaluates the waste products resulting from a truck repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.
- SC041 Applies/Uses Laboratory Techniques Safety
 - The technician follows all safety regulations and applicable procedures while working on the braking system.
- SC042 Applies/Uses Maps/Charts/Tables/Graphs
 - The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for components and the appropriate brake system repair/replacement procedure and/or part.
- SC044 Applies/Uses Scientific Methods
 - The technician develops a theory relative to the cause of the braking system problem based on the information provided, then tests the hypothesis to determine the solution.
- SC052 Converts Measurement Units English/Metric
 - The technician can convert measurements taken in the English or metric system to specifications stated in the other system.
- SC114 Describes/Explains Chemical Reactions
 - The technician can recognize and describe the effects of chemical reaction that occurs when contaminants are introduced into the brake system of a truck.

- SC177 Describes/Explains Electricity
- The technician can describe and explain the properties of electricity and how those properties are utilized in brake sub-system operation.
- SC180 Describes/Explains Conductors
- The technician can explain the difference between electrical conductors and insulators.
- SC182 Describes/Explains Current AC-DC
- The technician can explain the difference between direct and alternating current.
- SC184 Describes/Explains Electricity Ground
- The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.
- SC186 Describes/Explains Electricity Parallel/Series Circuits
- The technician can explain current flow and voltage in both parallel and series circuits.
- SC187 Describes/Explains Electricity Short Circuit
- The technician can demonstrate an understanding of the processes used to locate a short circuit in the brake system electrical and electronic components.
- SC198 Describes/Explains Electricity - Measurement
- The technician can demonstrate an understanding of the correct procedure to measure electrical/electronic circuits of the brake system.
- SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter
- The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a brake control circuit.
- SC201 Describes/Explains Electricity - Measurement Fuse
- The technician can demonstrate an understanding of and explain the role of a fuse or fusible link circuit breaker when used as a protective device in an electrical or electronic circuit.
- SC204 Describes/Explains Electricity - Measurement Resistance
- The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters as related to the brake system.
- SC205 Describes/Explains Electricity - Measurement Voltage
- The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.
- SC212 Describes/Explains Electrochemical Reactions Activity of Metals
- The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.
- SC214 Describes/Explains Electromagnetism
- The technician can explain the relationship between electrical current in a conductor and magnetic field when produced in a coil such as ABS system sensors.
- SC215 Describes/Explains Electromagnetism Coil
- The technician can explain the relationship between electrical current in a conductor and the magnetic field produced in a coil such as in the ABS sensor.
- SC233 Describes/Explains Energy Kinetic/Potential
- The technician can demonstrate an understanding of the kinetic and potential energy relationships that occur in stored energy systems such as springs and fluids.

SC249	Describes/Explains	Energy	Force, Balanced/Unbalanced
	- The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear and rotating assemblies in a malfunctioning braking system.		
SC251	Describes/Explains	Force	Friction
	- The technician can demonstrate an understanding of friction and its effects on linear and rotational motion in the brake system.		
SC255	Describes/Explains	Force	Pressure
	- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.		
SC273	Describes/Explains	Heat	
	- The technician can demonstrate an understanding of the effect of heat on the truck's braking system.		
SC274	Describes/Explains	Heat	Conduction/Convection
	- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various truck braking systems.		
SC349	Describes/Explains	Motion	Acceleration/Deceleration
	- The technician can demonstrate an understanding of the process of a truck's acceleration and deceleration as a function of weight to stopping distance.		
SC350	Describes/Explains	Motion	Action/Reaction
	- The technician can demonstrate an understanding of the reaction of fluid to the motion of a valve or piston in the brake system.		
SC351	Describes/Explains	Motion	Circular
	- The technician can demonstrate an understanding of circular motion in a part in a truck's brake system.		
SC356	Describes/Explains	Motion	Vibrations/Waves
	- The technician is able to demonstrate an understanding of the cause and types of vibrations caused by out-of-balance or warped brake rotor.		
SC396	Describes/Explains	Sound	
	- The technician can demonstrate an understanding of the role sound plays in the cause of various noise problems in the truck's brake system.		
SC399	Describes/Explains	Sound	Carriers/Insulators
	- The technician can demonstrate an understanding of how sound generated in one place in the brake system can be amplified due to resonant cavities and other physical characteristics of the truck/trailer.		
SC402	Describes/Explains	Sound	Decibels/Intensity
	- The technician can demonstrate an understanding of how sound intensity can be measured.		
SC404	Describes/Explains	Sound	Frequency-Hertz
	- The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating brake system.		
SC406	Describes/Explains	Sound	Noise/Acoustics
	- The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the truck and/or trailer.		
SC407	Describes/Explains	Sound	Overtones/Harmonics
	- The technician can explain that the presence of overtones may indicate changes in vibrations in various systems.		
SC408	Describes/Explains	Sound	Pitch/Frequency

- The technician can explain the relationships or pitch to frequency to the suspected brake system malfunction.
- SC411 Describes/Explains Sound Resonance
- The technician can demonstrate an understanding of what happens when an object resonates.
- SC445 Describes/Explains Work
- The technician can explain the relationship of weight and speed to vehicle braking performance.
- SC447 Describes/Explains Work Levers
- The technician can explain how levers can be used to increase an applied force over distance.
- SC448 Describes/Explains Work Pulleys
- The technician can explain how pulleys can be used to increase an applied force over distance.
- SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to brake system, diagnosis, service, and repair.
- SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if braking system wear and adjustments are within the manufacturer's specifications, and to assure that brake system replacement parts meet the manufacturer's specifications.
- SC492 Measures Force
- The technician uses gauges such as a torque wrench to measure the force required to tighten brake system component connections according to the manufacturer's specifications.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic brake systems and compares them to the manufacturer's specifications.
- SC496 Measures Time
- The technician uses direct and indirect methods to measure air system build-up time and compares the time to manufacturer's specifications.
- SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.
- SC501 Uses Computers Problem Solving
- The technician uses computers, input devices, and on-board data feeds to solve brake problems more efficiently.
- SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, and continuity on brake system electrical/electronic circuits.
- SC503 Describes/Explains Fluid System Hydraulics
- The technician can explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a wheel cylinder or brake caliper.
- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the operation of a pneumatic brake system.

- SC506 Describes/Explains Motion Friction
- The technician can explain how friction of the pad/shoe on the moving disc/drum wears both parts on the braking system.
- SC507 Describes/Explains Motion Lubrication
- The technician can discuss the role of lubrication in relation to the concept of friction.
- SC508 Describes/Explains Matter Metallurgy
- The technician can explain the criticality of having the correct disc/drum metals in the braking system.
- SC510 Describes/Explains Fluid System Dynamics
- The technician can explain the dynamic properties of a hydraulic system in the brake system.
- SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
- The technician can explain the surface process that occurs on system seals due to absorption of the various compounds.
- SC512 Describes/Explains Chemical Reactions Contamination
- The technician can demonstrate an understanding of the deterioration in the braking system components is due to a chemical reaction that occurs in contaminated brake fluid.
- SC513 Describes/Explains Force Torque
- The technician can describe how torque relates to the rotational force required to tighten fasteners to manufacturer's specifications.
- SC515 Describes/Explains Work Simple Machines
- The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in the brake system.
- SC516 Describes/Explains Motion Rotational
- The technician can explain how rotational motion of the wheel is decreased by the braking system.
- SC518 Describes/Explains Electricity Mechanical Transducers
- The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to operate the ABS system.
- SC520 Measures Flow Rate
- The technician can use precision gauges or instruments to measure the flow rate of air in a truck component or system.
- SC521 Describes/Explains Flow Rate
- The technician can demonstrate an understanding of how variances in flow rate can affect the functioning of a truck's brake system.
- SC522 Applies/Uses Ratio Proportion Mixtures
- The technician can correctly use proportions and ratios to calculate brake balance.
- SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how cohesive/adhesive forces aid in the use of various sealants.
- SC531 Describes/Explains Viscosity
- The technician can explain fluid viscosity as a measurement and why it is important to the functioning of the brake hydraulic system.

UNDULICATED RELATED ACADEMIC SKILLS

VI. ELECTRICAL/ELECTRONIC SYSTEMS

LANGUAGE ARTS:

- LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.
- LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the electrical/electronic problem.
- LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g., customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the electrical/electronic problem.
- LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for use in solving electrical/electronic problems.
- LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.
- LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.
- LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various components and electrical/electronic systems of the truck.
- LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g., shop manuals, references, and computer databases related to the truck electrical/electronic system.
- LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the electrical/electronic problem.
- LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar electrical/electronic system under review, then study the applicable information with the intensity necessary for the situation.
- LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the electrical/electronic task or system of the truck under study.

- LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve electrical/electronic problems.
- LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve electrical/electronic problems.
- LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.
- LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and solving electrical/electronic problems.
- LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.
- LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.
- LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.
- LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.
- LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.
- LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses electrical/electronic cause and effect relationships presented in service manual problem solving trees to diagnose problems in a component or system.
- LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for the electrical/electronic system operation.
- LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific electrical/electronic problem.
- LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing an electrical/electronic problem.

- LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information clearly and adequately when analyzing an electrical/electronic problem.
- LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.
- LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.
- LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to electrical/electronic problems based on discussions with customers, associates and supervisors.
- LA247 Infers/Predicts Information-Written
- The technician makes inferences and predicts the solution to the electrical/electronic problem from the information provided on the work order.
- LA256 Infers/Predicts Information-Written Outcomes/Solutions
- The technician makes inferences and solves problems from the information provided on the work order.
- LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the electrical/electronic problem from the customer, and possible solutions to the problem from associates and supervisors.
- LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.
- LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair of the electrical/electronic system.
- LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain electrical/electronic system information.
- LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain special electrical/electronic tools and equipment.
- LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for electrical/electronic system operation and potential malfunction.

MATH SKILLS (ELECTRICAL/ELECTRONIC SYSTEMS)

- MA001 Calculates/Evaluates Algebraic Expressions
- The technician can use Ohm's Law to determine electrical circuit parameters that are out-of-tolerance.
- MA013 Calculates/Evaluates Mean/Median/Mode
- The technician can calculate the average (mean) of several electrical/electronic measurements to

determine any variance from the manufacturer's specifications.

- MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.
- MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance of multiple electrical/electronic measurements with the manufacturer's specifications.
- MA034 Computes Addition Whole Numbers
- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.
- MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's electrical/electronic specifications.
- MA041 Computes Division Mentally
- The technician can mentally divide numbers to determine conformance with the manufacturer's electrical/electronic specifications.
- MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's electrical/electronic specifications.
- MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's electrical/electronic specifications.
- MA066 Computes Multiplication Fractions
- The technician can multiply numbers that include fractions to determine conformance with the manufacturer's electrical/electronic specifications.
- MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's electrical/electronic specifications.
- MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's electrical/electronic specifications.
- MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's electrical/electronic specifications.
- MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.

- MA092 Computes Subtraction Whole Numbers
 - The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA116 Converts Decimals/Fractions Ratios/Percents
 - The technician can convert test readings that are in decimal or fraction form to a ratio or percent form for comparison with the manufacturer's electrical/electronic specifications.
- MA126 Converts Units English/Metric -- Feet/Meters, e.g.
 - The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturer for specifying the correct measurement or tolerance.
- MA131 Distinguishes Equal/Not Equal
 - The technician can distinguish when an electrical/electronic measurement or tolerance is not equal to the manufacturer's specification.
- MA132 Distinguishes Estimate/Exact Value
 - The technician can distinguish the need to use an exact value versus an estimated value, depending upon the system malfunction.
- MA133 Distinguishes Proportion/Congruence
 - The technician can distinguish the congruence of measured tolerances with those specified by the manufacturer.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
 - The technician estimates the anticipated performance outcome of a normally operating system as well as expected outcome of everyday occurrences such as excessively high or low resistance within a circuit.
- MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
 - The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.
- MA161 Identifies English Measures Length/Volume/Weight
 - The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.
- MA171 Identifies Metric Measures Length/Volume/Weight
 - The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.
- MA172 Identifies Missing/Irrelevant Data Word Problems
 - The technician can discuss symptoms of problems with a customer or associate technician and identify any relevant missing data required to solve the problem.
- MA174 Interprets Charts/Tables/Graphs
 - The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for electrical/electronic system operation.
- MA176 Interprets Symbols <, >, =, e.g.
 - The technician interprets symbols to determine compliance with the manufacturer's specifications.

MA177	Interprets	System of Numbers	Place Value
	- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements using digital multimeters (DMM).		
MA180	Measures	Direct	Angles
	- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.		
MA181	Measures	Direct	Distance
	- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.		
MA182	Measures	Direct	Temperature
	- The technician can use appropriate temperature measurement tools and compare the results with manufacturer's specifications.		
MA183	Measures	Direct	Time
	- The technician can use time measurement tools and techniques to determine electrical/electronic system timed or sequenced operating parameters' conformance to manufacturer's specifications.		
MA184	Measures	Direct	Volume
	- The technician can use various methods of measurement to determine the volume.		
MA185	Measures	Direct	Weight
	- The technician uses scales to determine whether the weight of a given component is in conformance with the manufacturer's specified weight.		
MA190	Measures	Metric	Distance
	- The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.		
MA191	Measures	Metric	Temperature
	- The technician can use metric temperature measurement instruments.		
MA193	Measures	Metric	Weight
	- The technician can use metric weighing devices to determine the conformance of a weight to metric tolerances.		
MA228	Solves Problems	Fraction/Decimal/Ratio/Percent	Direct/Indirect Variation
	- The technician can analyze and solve problems requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.		
MA229	Solves Problems	Generates Conclusions	Deductive Reasoning
	- The technician can identify the specific cause of the described electrical/electronic problem by generating conclusions based on symptoms related to the problem.		
MA230	Solves Problems	Proportion	
	- The technician can solve problems that determine the proportion of variables of a solution and determine if that proportion is within the manufacturer's specifications.		
MA239	Understands	Conditionals	
	- The technician understands that if the described electrical/electronic problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.		
MA242	Understands	Definitions	Standards
	- The technician can use and conform to standards defined by each manufacturer for the electrical/electronic system being analyzed.		

- MA245 Understands Line/Angle Relationships
 - When diagnosing a system malfunction, the technician understands the necessity of verifying that the pulley and belt angle relationships concur with the manufacturer's specifications.
- MA258 Understands Statistics Probability
 - The technician understands that electrical/electronic problem symptoms are statistically related to the probability of specific part or system malfunctioning.
- MA271 Determines Proper Operation
 - The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing electrical/electronic system measurements to the manufacturer's specifications.
- MA272 Computes Proper Operations
 - The technician can accurately compute all arithmetic operations in the proper sequences to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA273 Computes Tolerances/Ranges Mentally
 - When comparing the circuit measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.
- MA274 Computes Proper Operations Mentally
 - The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.
- MA275 Identifies Temperatures Fahrenheit/Centigrade
 - The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.
- MA276 Understands Tolerances Ranges
 - The technician can choose the proper tool or instrument to determine if a specific system is within the tolerance or range specified by the manufacturer.

SCIENCE SKILLS (ELECTRICAL/ELECTRONIC SYSTEMS)

- SC007 Analyzes/Evaluates Environmental Issues
 - The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the truck technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of an electrical/electronic systems repair task.
- SC012 Analyzes/Evaluates Environmental Issues Waste Management
 - The technician evaluates the waste products resulting from a truck repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.
- SC041 Applies/Uses Laboratory Techniques Safety
 - The technician follows all safety regulations and applicable procedures while working with electrical/electronic systems.
- SC042 Applies/Uses Maps/Charts/Tables/Graphs
 - The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for electrical/electronic systems components and the appropriate repair/replacement procedure and/or part.

- SC044 Applies/Uses Scientific Methods
- The technician develops a theory relative to the cause of the electrical/electronic problem based on the information provided, then tests the hypothesis to determine the solution.
- SC052 Converts Measurement Units English/Metric
- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.
- SC114 Describes/Explains Chemical Reactions
- The technician can demonstrate an understanding of the chemical reaction that occurs in the charging and discharging of the lead/acid battery.
- SC177 Describes/Explains Electricity
- The technician can demonstrate an understanding of and explain the properties of electricity that impact the lighting, engine management, and other electrical/electronic components and systems of a truck.
- SC178 Describes/Explains Batteries
- The technician can demonstrate an understanding of the electrochemical reactions that occur in wet and dry cell batteries.
- SC180 Describes/Explains Conductors
- The technician can explain the difference between electrical conductors and insulators.
- SC182 Describes/Explains Current AC-DC
- The technician can explain the difference between direct and alternating current.
- SC184 Describes/Explains Electricity Ground
- The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.
- SC186 Describes/Explains Electricity Parallel/Series Circuits
- The technician can explain current flow and voltage in both parallel and series circuits.
- SC187 Describes/Explains Electricity Short Circuit
- The technician can demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.
- SC194 Describes/Explains Electricity - Generating Motors
- The technician can demonstrate an understanding of the role of the generator in maintaining battery and system voltage.
- SC197 Describes/Explains Electricity - Generating Transformers
- The technician can explain the ignition coil transformer's role in generating the high voltage required to fire the spark plug.
- SC198 Describes/Explains Electricity - Measurement
- The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, resistance, or power.
- SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter
- The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit using an ammeter and voltmeter (DVOM).
- SC201 Describes/Explains Electricity - Measurement Fuse
- The technician can demonstrate an understanding of and explain the role of a fuse or fusible link when used as a protective device in an electrical or electronic circuit.

- SC204 Describes/Explains Electricity - Measurement Resistance
 - The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.
- SC205 Describes/Explains Electricity - Measurement Voltage
 - The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.
- SC211 Describes/Explains Electrochemical Reactions
 - The technician can demonstrate an understanding of the electrochemical reaction that takes place in the lead/acid battery.
- SC212 Describes/Explains Electrochemical Reactions Activity of Metals
 - The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.
- SC213 Describes/Explains Electrochemical Reactions Oxidation/Reduction
 - The technician can explain the cause/effect of oxidation on electrical connections.
- SC214 Describes/Explains Electromagnetism
 - The technician can explain the relationship between electrical current in a conductor and magnetic field when produced in a coil such as the starter solenoid.
- SC215 Describes/Explains Electromagnetism Coil
 - The technician can explain how a coil can increase the battery voltage to the level required to fire a sparkplug.
- SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
 - The technician can explain the effect of magnetic fields on unshielded circuits in same control modules.
- SC251 Describes/Explains Force Friction
 - The technician can demonstrate an understanding of friction and its effects on linear and rotational motion in the truck's electrical system.
- SC255 Describes/Explains Force Pressure
 - The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.
- SC273 Describes/Explains Heat
 - The technician can demonstrate an understanding of the cause/effect of heat on truck electrical/electronic systems.
- SC277 Describes/Explains Heat Expansion/Contraction
 - The technician is able to demonstrate an understanding of the expansion and contraction of various electrical and electronic system parts as a result of normal thermal-cycling of the engine compartment.
- SC280 Describes/Explains Heat Insulation
 - The technician can explain the role of insulation in maintaining stable temperatures in the electrical/electronic systems.
- SC282 Describes/Explains Heat Temperature Measuring Devices
 - The technician can explain the operation of thermistors in ECT and IAT sensor systems.

- SC335 Describes/Explains Light Translucent/Transparent
- The technician can explain the difference between the principles of translucent as contrasted to transparent when dealing with the light and optical components of the truck.
- SC338 Describes/Explains Matter Density/Specific Gravity
- The technician can explain the need for a specific gravity test of battery electrolyte to determine charge.
- SC351 Describes/Explains Motion Circular
- The technician can demonstrate an understanding of circular motion in a truck as it relates to the electrical system.
- SC356 Describes/Explains Motion Vibrations/Waves
- The technician is able to demonstrate an understanding of the cause and types of vibrations caused by out-of-balance or excessively worn systems.
- SC396 Describes/Explains Sound
- The technician can demonstrate an understanding of the role sound plays in the cause of various noise problems in trucks.
- SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the electrical system can be carried to other parts of the cab, chassis, or engine through metal or other related materials.
- SC402 Describes/Explains Sound Decibels/Intensity
- The technician can demonstrate an understanding of how sound intensity can be measured.
- SC404 Describes/Explains Sound Frequency-Hertz
- The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating amplifier system.
- SC406 Describes/Explains Sound Noise/Acoustics
- The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the truck and/or trailer.
- SC407 Describes/Explains Sound Overtones/Harmonics
- The technician can explain that the presence of overtones may indicate changes in vibrations in various systems.
- SC408 Describes/Explains Sound Pitch/Frequency
- The technician can explain the relationships of pitch to frequency.
- SC411 Describes/Explains Sound Resonance
- The technician can demonstrate an understanding of what happens when an object resonates.
- SC443 Describes/Explains Weather/Climate Relative Humidity
- The technician can demonstrate an understanding of and discuss relative humidity in terms of its effect on electrical climate control systems for heating and air conditioning of the truck.
- SC447 Describes/Explains Work Levers
- The technician can explain how levers can be used to increase an applied force over distance.
- SC448 Describes/Explains Work Pulleys
- The technician can explain how pulleys can be used to increase an applied force over distance.

- SC449 Identifies Acids/Bases
- The technician can identify and explain the impact of acids and bases on the various components of the truck's electrical system.
- SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to electrical/electronic systems, diagnosis, service, and repair.
- SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.
- SC492 Measures Force
- The technician uses gauges such as a torque wrench to measure the force required to tighten connections according to the manufacturer's specifications.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic systems and compares them to the manufacturer's specifications.
- SC495 Measures Temperature Fahrenheit/Centigrade
- The technician uses direct and indirect electronic methods to measure temperatures and then converts them to Fahrenheit or Centigrade as required.
- SC496 Measures Time
- The technician uses direct and indirect methods to measure time and compares the results to the manufacturer's specifications as it applies to the electrical/electronic system.
- SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of liquids in components of the electrical/electronic system and compares the volume to manufacturer's specifications.
- SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.
- SC501 Uses Computers Problem Solving
- The technician uses computer databases to retrieve information and solve electrical/electronic system problems.
- SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power.
- SC506 Describes/Explains Motion Friction
- The technician can explain the role that friction plays in the acceleration and deceleration of objects as well as the need for lubrication of adjacent parts in order to minimize friction.
- SC508 Describes/Explains Matter Metallurgy
- The technician can explain the criticality of metals with different properties, depending on the function and location of the metal within the electrical component or system of a truck.
- SC509 Describes/Explains Electricity Capacitance
- The technician can demonstrate an understanding of the role of capacitance in timer circuits, such as RC timers or a MAP sensor wherein the changing manifold pressure causes two metal discs to act like a capacitor, sending a varying voltage to the electronic engine control system.

- SC512 Describes/Explains Chemical Reactions Contamination
 - The technician can demonstrate an understanding of how chemical contamination can cause a chemical reaction which can result in the deterioration of an electrical component used in the truck.
- SC514 Describes/Explains Electricity Semiconductor Devices
 - The technician can demonstrate an understanding of the ability of semiconductor devices to rapidly modify engine operating parameters depending on multiple inputs from engine sensors.
- SC515 Describes/Explains Work Simple Machines
 - The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in a mechanical system.
- SC516 Describes/Explains Motion Rotational
 - The technician can explain how rotational motion can be used to move an electromechanical field past a conductor to induce current flow in that conductor.
- SC517 Describes/Explains Electricity-Generating Generators
 - The technician can demonstrate an understanding of how a conductor in a magnetic field can generate electricity.
- SC518 Describes/Explains Electricity Mechanical Transducers
 - The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the system's operating characteristics.

UNDULICATED RELATED ACADEMIC SKILLS

VII. HEATING AND AIR CONDITIONING

LANGUAGE ARTS:

- LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.
- LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the heating and air conditioning problem.
- LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g., customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the heating and air conditioning problem.
- LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for use in problem solving.
- LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.
- LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.
- LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various heating and air conditioning components and systems of the truck.
- LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g., shop manuals, references, and computer databases related to the heating and air conditioning system.
- LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the heating and air conditioning problem.
- LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.
- LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the heating and air conditioning task or system of the truck.

- LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.
- LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.
- LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the heating and air conditioning problem analysis and solution process.
- LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.
- LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.
- LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.
- LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.
- LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding heating and air conditioning problem symptoms and potential solutions.
- LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.
- LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in the heating and air conditioning system.
- LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for the heating and air conditioning component system.
- LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific heating and air conditioning problem.
- LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a problem.

- LA180 Evaluates Information-Written
 - The technician evaluates the usefulness of available written information when analyzing a heating and air conditioning problem.
- LA215 Identifies Information-Written Abbreviations/Acronyms
 - The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.
- LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
 - The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.
- LA236 Infers/Predicts Information-Oral
 - The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.
- LA247 Infers/Predicts Information-Written
 - The technician makes inferences and predicts the solution to the problem from the information provided on the work order.
- LA256 Infers/Predicts Information-Written Outcomes/Solutions
 - The technician makes inferences and solves problems from the information provided on the work order.
- LA266 Presents Informal Speech Information Requests
 - The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.
- LA267 Presents Informal Speech Information Supplying
 - The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.
- LA278 Uses Text Resources
 - The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for heating and air conditioning diagnosis and repair.
- LA283 Uses Media Resources Databases
 - The technician uses computerized and other databases to obtain heating and air conditioning system information.
- LA285 Comprehends Information-Written Operator's Manual
 - The technician can comprehend and apply information in the operator's manuals to operate and maintain heating and air conditioning specialty tools and equipment.
- LA286 Uses Text Resources Service (Shop) Manual
 - The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for heating and air conditioning system operation, component specifications, and potential malfunctions.

MATH SKILLS (HEATING & AIR CONDITIONING)

- MA001 Calculates/Evaluates Algebraic Expressions
- The technician can use Ohm's Law to determine heating and air conditioning circuit parameters that are out-of-tolerance.
- MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's heating and air conditioning specifications.
- MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's heating and air conditioning specifications.
- MA034 Computes Addition Whole Numbers
- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's heating and air conditioning specifications.
- MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's heating and air conditioning specifications.
- MA041 Computes Division Mentally
- The technician can mentally divide numbers to determine conformance with the manufacturer's heating and air conditioning specifications.
- MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's heating and air conditioning specifications.
- MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's heating and air conditioning specifications.
- MA066 Computes Multiplication Fractions
- The technician can multiply numbers that include fractions to determine conformance with the manufacturer's heating and air conditioning specifications.
- MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's heating and air conditioning specifications.
- MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's heating and air conditioning specifications.
- MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's heating and air conditioning specifications.
- MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's heating and air conditioning specifications.

- MA092 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.
- MA097 Constructs Charts/Graphs/Tables
- The technician can construct a chart, table, or graph that depicts a range of performance characteristics of various heating and air conditioning system operational conditions that can be used for comparisons.
- MA116 Converts Decimals/Fractions Ratios/Percents
- The technician can convert test readings that are in decimal or fraction form to a ratio or percent form for comparison with the manufacturer's specifications.
- MA126 Converts Units English/Metric -- Feet/Meters, e.g.
- The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturer for specifying the correct measurement or tolerance.
- MA131 Distinguishes Equal/Not Equal
- The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.
- MA132 Distinguishes Estimate/Exact Value
- The technician can distinguish the need to use an exact value versus an estimated value, depending upon the heating and air conditioning service operation.
- MA133 Distinguishes Proportion/Congruence
- The technician can distinguish the congruence of measured tolerances with those specified by the manufacturer.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
- The technician estimates the anticipated performance outcome of a normally operating heating and air conditioning system as well as expected outcome of everyday occurrences such as changes in ambient temperature and humidity.
- MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
- The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.
- MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle and verify its conformance to the manufacturer's specified angle.
- MA161 Identifies English Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.
- MA171 Identifies Metric Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.
- MA172 Identifies Missing/Irrelevant Data Word Problems
- The technician can discuss symptoms of problems with a customer or associate technician and identify any relevant missing data required to solve the problem.
- MA174 Interprets Charts/Tables/Graphs

- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for heating and air conditioning system operation.
- MA176 Interprets Symbols <, >, =, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's specifications.
- MA177 Interprets System of Numbers Place Value
- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.
- MA180 Measures Direct Angles
- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.
- MA181 Measures Direct Distance
- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's specifications for compressor clutch drive plate clearance.
- MA182 Measures Direct Temperature
- The technician can use appropriate temperature measurement tools to determine operating temperature of a heating and air conditioning system.
- MA184 Measures Direct Volume
- The technician can use various methods of measurement to determine the volume of compressor oil.
- MA185 Measures Direct Weight
- The technician uses scales to determine whether the weight of a given component is in conformance with the manufacturer's specified weight.
- MA190 Measures Metric Distance
- The technician can use metric measurement instruments to determine correct distances in the metric system.
- MA191 Measures Metric Temperature
- The technician can use metric temperature measurement instruments to determine heating and air conditioning system temperature and determine conformance to metric specifications.
- MA193 Measures Metric Weight
- The technician can use metric weighing devices to determine the conformance of a weight to metric tolerances.
- MA228 Solves Problems Fraction/Decimal/Ratio/Percent Direct/Indirect Variation
- The technician can analyze and solve problems requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.
- MA229 Solves Problems Generates Conclusions Deductive Reasoning
- The technician can identify the specific cause of the described problem by generating conclusions based on known symptoms related to the problem.
- MA230 Solves Problems Proportion
- The technician can solve problems that determine the proportion of variables of a solution and determine if that proportion is within the manufacturer's specifications.
- MA232 Solves Problems Proportion Volume
- The technician can solve problems that involve determining whether the proportion of the existing volume

is within recommended tolerance when compared to the manufacturer's specifications.

- MA239 Understands Conditionals
- The technician understands that if the described problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.
- MA242 Understands Definitions Standards
- The technician can use and conform to standards defined by each manufacturer for the heating and air conditioning system being analyzed.
- MA271 Determines Proper Operation
- The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA272 Computes Proper Operations
- The technician can accurately compute all arithmetic operations in the proper sequences to arrive at a solution when comparing system measurements to the manufacturer's specifications.
- MA273 Computes Tolerances/Ranges Mentally
- When comparing heating and air conditioning system measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.
- MA274 Computes Proper Operations Mentally
- The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.
- MA275 Identifies Temperatures Fahrenheit/Centigrade
- The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.
- MA276 Understands Tolerances Ranges
- The technician can choose the proper tool or instrument to determine if a specific system is within the tolerance or range specified by the manufacturer.

SCIENCE SKILLS (HEATING & AIR CONDITIONING)

- SC007 Analyzes/Evaluates Environmental Issues
- The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the truck technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a heating and air conditioning repair task.
- SC012 Analyzes/Evaluates Environmental Issues Waste Management
- The technician evaluates the waste products resulting from a heating and air conditioning repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.
- SC041 Applies/Uses Laboratory Techniques Safety
- The technician follows all safety regulations and applicable procedures while working on the heating and air conditioning system.
- SC042 Applies/Uses Maps/Charts/Tables/Graphs
- The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for heating and air conditioning system operation and the appropriate repair/replacement procedure and/or part.

- SC044 Applies/Uses Scientific Methods
- The technician develops a theory relative to the cause of the heating and air conditioning problem based on the information provided, then tests the hypothesis to determine the solution.
- SC052 Converts Measurement Units English/Metric
- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.
- SC114 Describes/Explains Chemical Reactions
- The technician can demonstrate an understanding of the chemical reactions that occur in the truck related to contamination introduced into the heating and air conditioning system.
- SC121 Describes/Explains Chemical Reactions Inhibitors
- The technician can explain the purpose of adding additives to the truck's cooling system.
- SC177 Describes/Explains Electricity
- The technician can demonstrate an understanding of and explain the properties of electricity that impact the management of the heating and air conditioning system of the truck.
- SC180 Describes/Explains Conductors
- The technician can explain the difference between electrical conductors and insulators as related to the heating and air conditioning electrical system.
- SC182 Describes/Explains Current AC-DC
- The technician can explain the difference between direct and alternating current.
- SC184 Describes/Explains Electricity Ground
- The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.
- SC186 Describes/Explains Electricity Parallel/Series Circuits
- The technician can explain current flow and voltage in both parallel and series circuits.
- SC187 Describes/Explains Electricity Short Circuit
- The technician can demonstrate an understanding of the processes used to locate a short circuit in the heating and air conditioning electrical/electronic system.
- SC194 Describes/Explains Electricity - Generating Motors
- The technician can demonstrate an understanding of the role of the generator in maintaining battery and system voltage.
- SC198 Describes/Explains Electricity - Measurement
- The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, and/or resistance.
- SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter
- The technician can demonstrate an understanding of how to correctly measure electrical current and voltage using an ammeter and voltmeter.

- SC201 Describes/Explains Electricity - Measurement Fuse
 - The technician can demonstrate an understanding of and explain the role of a fuse or fusible link circuit breaker when used as a protective device in an electrical or electronic circuit of the heating and air conditioning system.
- SC204 Describes/Explains Electricity - Measurement Resistance
 - The technician can demonstrate an understanding of the relationship of resistance to the generation of heat, voltage drop, and heating and air conditioning circuit parameters.
- SC205 Describes/Explains Electricity - Measurement Voltage
 -The technician can demonstrate and explain how to measure and interpret heating and air conditioning voltage readings.
- SC214 Describes/Explains Electromagnetism
 - The technician can explain the relationship between electrical current in a conductor and the magnetic field produced in the coil of the heating and air conditioning compressor clutch.
- SC215 Describes/Explains Electromagnetism Coil
 - The technician can explain the effect of an electrical current through a coil in the compressor clutch.
- SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
 - The technician can explain the effect of magnetic fields on unshielded circuits in control modules of a heating and air conditioning circuit.
- SC249 Describes/Explains Energy Force, Balanced/Unbalanced
 - The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating assemblies of the vehicle's heating and air conditioning system.
- SC250 Describes/Explains Force Centrifugal/Centripetal
 - The technician can explain the relationship of centrifugal/centripetal force to the functioning or failure of a rotating device in the heating and air conditioning system of the truck.
- SC251 Describes/Explains Force Friction
 - The technician can demonstrate an understanding of friction and its effects on linear and rotational motion.
- SC255 Describes/Explains Force Pressure
 - The technician can describe pressure relationships in the heating and air conditioning system.
- SC273 Describes/Explains Heat
 - The technician can demonstrate an understanding of the effect of heat on the truck's heating and air conditioning system.
- SC274 Describes/Explains Heat Conduction/Convection
 - The technician is able to explain the concept of heat transfer in terms of conduction and/or convection in truck heating and air conditioning system failure.
- SC277 Describes/Explains Heat Expansion/Contraction
 - The technician is able to describe the expansion and contraction of refrigerant during the cooling cycle.
- SC278 Describes/Explains Heat Fusion/Vaporization
 - The technician can describe the effect of adding heat that will cause a change in state of matter, such as from a solid to a liquid to a gas.
- SC280 Describes/Explains Heat Insulation
 - The technician can explain the role of insulation in maintaining stable temperatures.

- SC282 Describes/Explains Heat Temperature Measuring Devices
- The technician can describe processes and associated devices for measuring heating and air conditioning system temperatures.
- SC341 Describes/Explains Matter Phases/States
- The technician can describe phase and state changes in the heating and air conditioning cooling cycle.
- SC351 Describes/Explains Motion Circular
- The technician can demonstrate an understanding of circular motion in heating and air conditioning components in a truck.
- SC356 Describes/Explains Motion Vibrations/Waves
- The technician is able to demonstrate an understanding of the cause and types of vibrations caused by out-of-balance or excessively worn heating and air conditioning parts.
- SC396 Describes/Explains Sound
- The technician can demonstrate an understanding of the role sound plays in the cause of various noise problems in the truck's heating and air conditioning system.
- SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the heating and air conditioning system can be carried to other parts of the cab, chassis, or engine through metal or other related materials.
- SC402 Describes/Explains Sound Decibels/Intensity
- The technician can describe the relationship of the decibel level of noise and the perceived intensity.
- SC404 Describes/Explains Sound Frequency-Hertz
- The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating heating and air conditioning system.
- SC406 Describes/Explains Sound Noise/Acoustics
- The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the truck and/or trailer.
- SC407 Describes/Explains Sound Overtones/Harmonics
- The technician can explain that the presence of overtones may indicate multiple vibrations in various systems.
- SC408 Describes/Explains Sound Pitch/Frequency
- The technician can explain the relationships of pitch to frequency in analyzing noise problems in the heating and air conditioning system.
- SC411 Describes/Explains Sound Resonance
- The technician can demonstrate an understanding of what happens when an object resonates.
- SC443 Describes/Explains Weather/Climate Relative Humidity
- The technician can demonstrate an understanding of and discuss how the heating and air conditioning system removes excessive humidity from the vehicle.
- SC448 Describes/Explains Work Pulleys
- The technician can explain how pulleys can be used to increase an applied force over distance in the control system of the heating and air conditioning system.
- SC449 Identifies Acids/Bases
- The technician can identify pH level of the air conditioning compressor oil.

- SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to heating and air conditioning systems, diagnosis, service, and repair.
- SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that heating and air conditioning replacement parts meet the manufacturer's specifications.
- SC492 Measures Force
- The technician uses gauges such as a torque wrench to measure the force required to tighten heating and air conditioning connections according to the manufacturer's specifications.
- SC493 Measures Mass/Weight
- The technician uses a scale to measure refrigerant weight for the heating and air conditioning system.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic systems and compares them to the manufacturer's specifications.
- SC495 Measures Temperature Fahrenheit/Centigrade
- The technician uses direct and indirect methods to measure system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer.
- SC496 Measures Time
- The technician uses direct and indirect methods to measure time and compares the results to the manufacturer's specifications.
- SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of lubricants in the heating and air conditioning system and compares the results to the manufacturer's specifications.
- SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.
- SC501 Uses Computers Problem Solving
- The technician uses computers and other input devices to solve heating and air conditioning system problems.
- SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power in the heating and air conditioning system.
- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems.
- SC506 Describes/Explains Motion Friction
- The technician can explain the need for lubrication of adjacent parts in order to minimize friction as a result of movement at the junction of parts in the heating and air conditioning system.
- SC508 Describes/Explains Matter Metallurgy
- The technician can explain the criticality of metals with different thermal properties, depending on the function and location of the metal within the heating and air conditioning component or system of the truck.
- SC510 Describes/Explains Fluid System Dynamics
- The technician can explain the fluid system dynamic control properties of a heating and air conditioning

system.

- SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
- The technician can explain the surface process that occurs on heating and air conditioning system seals due to absorption of the contained materials.
- SC512 Describes/Explains Chemical Reactions Contamination
- The technician can describe the deterioration in performance due to a chemical reaction that occurs in a contaminated fluid in the heating and air conditioning system.
- SC513 Describes/Explains Force Torque
- The technician can demonstrate an understanding of how torque relates to force and angular acceleration of components of the heating and air conditioning system.
- SC514 Describes/Explains Electricity Semiconductor Devices
- The technician can demonstrate an understanding of the capacity of semiconductor devices to control heating and air conditioning operations depending on multiple inputs from sensors inside and outside the vehicle.
- SC515 Describes/Explains Work Simple Machines
- The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in a mechanical system.
- SC516 Describes/Explains Motion Rotational
- The technician can explain how rotational motion can be changed to linear motion in the air conditioning compressor and why balance is important in these rotating systems.
- SC518 Describes/Explains Electricity Mechanical Transducers
- The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the heating and air conditioning system's operating characteristics.
- SC519 Describes/Explains Electricity Photocells
- The technician can demonstrate an understanding of the purpose of photocells in a heating and air conditioning system and the measurement processes used to determine its output.
- SC520 Measures Flow Rate
- The technician can use precision gauges or instruments to measure the flow rate of air in a truck component or system.
- SC521 Describes/Explains Flow Rate
- The technician can demonstrate an understanding of how variances in flow rate can affect the functioning of a truck system.
- SC522 Applies/Uses Ratio Proportion Mixtures
- The technician can correctly use proportions and ratios in mixing coolants for the heating and air conditioning system.
- SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in the use of various sealants in the heating and air conditioning system.

UNDULICATED RELATED ACADEMIC SKILLS

VIII. PREVENTIVE MAINTENANCE INSPECTION

LANGUAGE ARTS:

- LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g., customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the problem.
- LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various components and systems of the truck.
- LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g., shop manuals, references, and computer databases related to the truck.
- LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the problem.
- LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.
- LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the task or system of the truck under study.
- LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.
- LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.
- LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.
- LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.
- LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.

- LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a component or system.
- LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for component or system alignment.
- LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.
- LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information clearly and adequately when analyzing a problem.
- LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.
- LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.
- LA256 Infers/Predicts Information-Written Outcomes/Solutions
- The technician makes inferences and solves problems from the information provided on the work order.
- LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.
- LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.
- LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain truck tools and equipment.
- LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and formulas for mixing various compounds.

MATH SKILLS (PREVENTATIVE MAINTENANCE INSPECTION)

- MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle, (e.g. suspension system, cab, or chassis component alignment) and verify its conformance to the manufacturer's specified angle.
- MA174 Interprets Charts/Tables/Graphs
- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.
- MA176 Interprets Symbols $<$, $>$, $=$, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's specifications.

- MA180 Measures Direct Angles
- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.
- MA181 Measures Direct Distance
- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.
- MA184 Measures Direct Volume
- The technician can use various methods of measurement to determine the volume of selected compounds and solutions.
- MA276 Understands Tolerances Ranges
- The technician can choose the proper tool or instrument to determine if a specific system is within the tolerance or range specified by the manufacturer.

SCIENCE SKILLS (PREVENTATIVE MAINTENANCE INSPECTION)

- SC041 Applies/Uses Laboratory Techniques Safety
- The technician follows all safety regulations and applicable procedures while performing the task.
- SC042 Applies/Uses Maps/Charts/Tables/Graphs
- The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for components and the appropriate repair/replacement procedure and/or part.
- SC044 Applies/Uses Scientific Methods
- The technician develops a theory relative to the cause of the problem based on the information provided, then tests the hypothesis to determine the solution. Major steps include: ① identify the problem; ② gather information; ③ develop hypothesis; ④ take action; ⑤ check results.
- SC177 Describes/Explains Electricity
- The technician can demonstrate an understanding of and explain the properties of electricity that impact the lighting, engine management, and other electrical systems of a truck.
- SC198 Describes/Explains Electricity - Measurement
- The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, and/or resistance.
- SC408 Describes/Explains Sound Pitch/Frequency
- The technician can explain the relationships of pitch to frequency.
- SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.
- SC492 Measures Force
- The technician uses gauges such as a torque wrench to measure the force required to tighten connections according to the manufacturer's specifications.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic systems

and compares them to the manufacturer's specifications.

- SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of liquids in a mixture for adhesion purposes.
- SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.
- SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, and continuity.
- SC513 Describes/Explains Force Torque
- The technician can demonstrate an understanding of how torque relates to force and angular acceleration.

TASK LIST AND ASSUMPTIONS

The NATEF task list was reviewed and updated in November 2007. A national committee was assembled in Herndon, Virginia to review the standards used in the Medium/Heavy Truck certification program. The committee consisted of individuals representing the major truck manufacturers, truck repair shop owners and technicians, truck instructors and trainers, and truck equipment and parts suppliers.

The committee reviewed the task list, tools and equipment list, program hours, and instructor qualifications. The committee also had the most current National Institute for Automotive Service Excellence (ASE) truck task lists for reference purposes.

All the tasks are assigned a priority number: P-1, P-2, or P-3. Please refer to the Task List Information in the Policies section and Standard 6.5 for additional information on the requirements for instruction on tasks.

Theory instruction and hands-on performance of all the basic tasks will provide initial training for **entry-level** employment in the Medium/Heavy Truck service field or further training in any, or all of the specialty areas. Competency in these tasks will indicate to employers that the graduate is skilled in that area.

1. It is assumed that:

- * in all areas, appropriate theory, safety, and support instruction will be required in the performance of each task;
- * this instruction includes identification and use of the appropriate tools and testing and measurement equipment required to accomplish certain tasks;
- * the student has received the necessary training to locate and use current reference and training materials from accepted industry resources (paper and electronic formats).

2. It is assumed that:

- * all diagnostic and repair tasks described in this document will be accomplished and verified in accordance with manufacturers' recommended procedures and industry accepted standards/practices.

3. It is assumed that:

- * individual training programs being evaluated for certification will have written and detailed performance standards for each task covered and taught in the curriculum (Standard 6.7);
- * the learning progress of students will be monitored and evaluated against these performance standards;
- * a system is in place which informs all students of their individual progress through all phases of the training program (Standard 6.6).

4. It is assumed that:

- * individual courses of study will differ across medium/heavy truck technician training programs;
- * development of appropriate learning delivery systems and tests which monitor student progress will be the responsibility of the individual training program.

5. It is assumed that:

- * all students will receive instruction in the storage, handling, and use of Hazardous Materials in accordance with Hazard Communication Title 29, Code of Federal Regulation Part 1910.1200, the 'Right to Know Law', and state and local requirements;
- * hazardous and toxic materials will be handled, removed, and recycled or disposed of according to federal, state, and local regulations.

6. It is assumed that:

- * any tool requiring calibration will be calibrated according to the manufacturer's specifications periodically or as needed.

7. It is assumed that:

- * students are given instruction in communication techniques with the customer.

8. It is assumed that:

- * all students will be instructed in and will practice recommended precautions when handling electro-static sensitive devices.

Note: The Technology and Maintenance Council (TMC) of the American Trucking Association (ATA) publishes a "Recommended Maintenance Practices Manual" as a resource for industry practices. Contact the TMC at www.trucking.org for more information.

DEFINITIONS – TECHNICAL TERMS

ADD – To increase fluid or pressure to the correct level or amount.

ADJUST – To bring components to specified operational settings.

AIR TEST – To use air pressure to determine proper action of components.

ALIGN – To bring to precise alignment or relative position of components.

ANALYZE – To examine the relationship of components of an operation.

ASSEMBLE (REASSEMBLE) – To fit together the components of a device.

BALANCE – To establish correct linear, rotational or weight relationship.

BLEED – To remove air from a closed system.

CHARGE – To bring to "full" state; e.g., battery or air conditioning system.

CHECK – To verify condition by performing an operational or comparative examination.

CLEAN – To rid component of extraneous matter for the purpose of reconditioning, repairing, measuring or reassembling.

DATA – Factual information, especially organized for analysis or used to reason or make decisions. Also, numerical or other information represented in a form suitable for processing by computer.

DEGLAZE – To restore correct surface finish.

DETERMINE – To establish the procedure to be used to affect the necessary repair.

DETERMINE NECESSARY ACTION – Indicates that the diagnostic routine(s) is the primary emphasis of a task. The student is required to perform the diagnostic steps and communicate the diagnostic outcomes and corrective actions required addressing the concern or problem. The training program determines the communication method (worksheet, test, verbal communication, or other means deemed appropriate) and whether the corrective procedures for these tasks are actually performed.

DIAGNOSE – To locate the root cause or nature of a problem by using the specified procedure.

DISASSEMBLE – To separate a component's parts as a preparation for cleaning, inspection, or service.

DISCHARGE – To empty a storage device or system; e.g. static electricity release, battery, or air conditioning system.

DRAIN – To use gravity to empty a container.

EVACUATE – To remove air, fluid or vapor from a closed system by use of a vacuum pump.

FILL (REFILL) – To bring fluid level to specified point or volume.

FIND – To locate a particular problem, e.g. shorts, grounds or opens in an electrical circuit.

FLUSH – To use a fluid to clean an internal system.

HONE – To restore, resize or bore by using rotating cutting stones.

IDENTIFY – To establish the identity of a vehicle or component prior to service; to determine the nature or degree of a problem.

INDICATE – To show as by measuring or recording such as a thermometer. Also, to point out or direct attention to a condition.

INSPECT – (See CHECK)

INSTALL (REINSTALL) – To place a component in its proper position in a system.

INTERFACE – To establish a communications link between an electronic control module and a diagnostic tool or computer.

ISOLATE – A technique where a component or system may be separated from the rest of the component or system.

JUMP START – To use an auxiliary power supply, i.e. battery, battery charger, etc. to assist a vehicle's battery to crank an engine.

LEAK TEST – To locate the source of leaks in a component or system.

LISTEN – To use audible clues in the diagnostic process; to hear the customer's description of a particular problem.

LOAD TEST – The process of creating demand on a system or device and measuring its Response.

LUBRICATE – To employ the correct procedures and materials in performing the prescribed lubrication service.

MEASURE – To compare existing dimensions to specified dimensions by the use of calibrated

instruments and gauges.

MOUNT – To attach or place tool or component in proper position.

OBSERVE – To watch, view, or note for a specific purpose.

PERFORM – To accomplish a procedure presented in a single task, at least one of the scenarios must be accomplished.

PERFORM NECESSARY ACTION – Indicates that the student is to perform the diagnostic routine(s) and perform the corrective action item. Where various scenarios (conditions or situations) are presented in a single task, at least one of the scenarios must be accomplished.

PRESSURE TEST – To use air or fluid pressure to determine the condition or operation of a component or system.

PRIORITY RATINGS – Indicates the minimum percentage of tasks, by area, a program must include in its curriculum in order to be certified in that area.

PURGE – To eliminate an undesired air or fluid from a closed system.

READY – To prepare a system or component for service, installation or operation.

REASSEMBLE – (SEE ASSEMBLE)

RECOVER – To remove a substance, in any condition, from a system and store it in an external container.

REFILL – (SEE FILL)

REINSTALL – (SEE INSTALL)

REMOVE – To disconnect and separate a component from a system.

REPAIR – To restore a malfunctioning component or system to operating condition.

REPLACE – To exchange an unserviceable component with a new or rebuilt component; to reinstall a component.

RESET (SET) – To adjust a variable component to a given, usually initial, specification.

SCAN – To read (data) for use by a computer or computerized device.

SELECT – To choose the correct part or setting during assembly or adjustment.

SERVICE – To perform a specified procedure when called for in the owner's or service manual.

TEST – To verify condition through the use of meters, gauges or instruments.

TIME – To adjust the timed relationship between the injection and/or ignition cycle(s) and engine cycle; or to set the operating relationship between two or more components or systems.

TRIM – (SEE ADJUST)

TORQUE – To tighten a fastener to specified degree or tightness (in a given order or pattern if multiple fasteners are involved on a single component).

VACUUM TEST – To determine the integrity and operation of a vacuum (negative pressure) operated component and/or system.

VERIFY – To establish that a problem exists after hearing the customer's complaint and performing a preliminary diagnosis; or to confirm that completed repairs address the customer complaint or problem.

NATEF TASK LIST

DIESEL ENGINES

For every task in Diesel Engines, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Diesel Engines is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

I. DIESEL ENGINES

A. General

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|----|---|-----|
| 1. | Inspect fuel, oil, and coolant levels, and condition; determine needed action. | P-1 |
| 2. | Identify the causes of engine fuel, oil, coolant, air, and other leaks; determine needed action. | P-1 |
| 3. | Listen for engine noises; determine needed action. | P-3 |
| 4. | Observe engine exhaust smoke color and quantity; determine needed action. | P-3 |
| 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. | P-1 |
| 6. | Identify causes of surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action. | P-1 |
| 7. | Identify engine vibration problems; determine needed action. | P-2 |
| 8. | Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; verify customer programmable parameters; clear codes; determine further diagnosis. | P-1 |

B. Cylinder Head and Valve Train

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

C. Engine Block

1. Perform crankcase pressure test; determine needed action. P-1
2. Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components. P-2

3. 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. P-2
4. Inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed action. P-2
5. Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed action. P-2
6. Replace/reinstall cylinder liners and seals; check and adjust liner height (protrusion). P-2
7. Inspect in-block camshaft bearings for wear and damage; determine needed action. P-3
8. Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play. P-3
9. Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action. P-2
10. Inspect main bearings for wear patterns and damage; replace as needed; check bearing clearances; check and correct crankshaft end play. P-2
11. Inspect, install, and time gear train; measure gear backlash; determine needed action. P-2
12. Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings; perform needed action. P-2
13. Determine piston-to-cylinder wall clearance; check ring-to-groove fit and end gap; install rings on pistons. P-3
14. Assemble pistons and connecting rods; install in block; install rod bearings and check clearances. P-2
15. Check condition of piston cooling jets (nozzles); determine needed action. P-2
16. Inspect and measure crankshaft vibration damper; determine needed action. P-3
17. Install and align flywheel housing; inspect flywheel housing(s) to P-3

transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action.

18. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action. P-2

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

E. Cooling System

1. Check engine coolant type, level, condition, and consumption; test coolant for freeze protection and additive package concentration; determine needed action. P-1
2. Test coolant temperature and check operation of temperature and level sensors, gauge, and/or sending unit; determine needed action. P-1
3. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment. P-1

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| 4. | Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed. | P-2 |
| 5. | Recover, flush, and refill with recommended coolant/additive package; bleed cooling system. | P-1 |
| 6. | Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed. | P-1 |
| 7. | Inspect water pump and hoses; replace as needed. | P-1 |
| 8. | Inspect, clean, and pressure test radiator, pressure cap, tank(s), and recovery systems; determine needed action. | P-1 |
| 9. | Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed. | P-1 |

F. Air Induction and Exhaust Systems

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|-----|---|-----|
| 1. | Perform air intake system restriction and leakage tests; determine needed action. | P-1 |
| 2. | Perform intake manifold pressure (boost) test; determine needed action. | P-1 |
| 3. | Perform exhaust back pressure test; determine needed action. | P-2 |
| 4. | Inspect turbocharger(s), wastegate, and piping systems; determine needed action. | P-2 |
| 5. | Inspect and test turbocharger(s) (variable ratio/geometry VGT), pneumatic, hydraulic, electronic controls, and actuators. | P-3 |
| 6. | Check air induction system: piping, hoses, clamps, and mounting; service or replace air filter as needed. | P-1 |
| 7. | Remove and reinstall turbocharger/wastegate assembly. | P-3 |
| 8. | Inspect intake manifold, gaskets, and connections; replace as needed. | P-3 |
| 9. | Inspect, clean, and test charge air cooler assemblies; inspect aftercooler assemblies; replace as needed. | P-2 |
| 10. | Inspect exhaust manifold, piping, mufflers, and mounting hardware; repair or replace as needed. | P-2 |
| 11. | Inspect exhaust after treatment devices; determine necessary action. | P-3 |

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| 12. | Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action. | P-2 |
| 13. | Inspect and test exhaust gas recirculation (EGR) system including EGR valve, cooler, piping, filter, electronic sensors, controls, and wiring; determine needed action. | P-3 |

G. Fuel System

1. Fuel Supply System

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| 1. | Check fuel level, and condition; determine needed action. | P-1 |
| 2. | Perform fuel supply and return system tests; determine needed action. | P-1 |
| 3. | Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determine needed action. | P-1 |
| 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. | P-1 |
| 5. | Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determine needed action. | P-1 |
| 6. | Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump. | P-1 |

2. Electronic Fuel Management System

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|----|---|-----|
| 1. | Inspect and test power and ground circuits and connections; measure and interpret voltage, voltage drop, amperage, and resistance readings using a digital multimeter (DMM); determine needed action. | P-1 |
| 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. | P-1 |
| 3. | Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; clear codes; determine further diagnosis. | P-1 |
| 4. | Locate and use relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams). | P-1 |

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| 5. | Inspect and replace electrical connector terminals, seals, and locks. | P-1 |
| 6. | Inspect and test switches, sensors, controls, actuator components, and circuits; adjust or replace as needed. | P-1 |
| 7. | Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), access and interpret customer programmable parameters. | P-2 |
| 8. | Inspect, test, and adjust electronic unit injectors (EUI); determine needed action. | P-2 |
| 9. | Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable). | P-2 |
| 10. | Perform cylinder contribution test utilizing recommended electronic diagnostic tool. | P-1 |
| 11. | Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action. | P-2 |
| 12. | Perform on-engine inspections and tests on hydraulic electronic unit injector high pressure oil supply and control systems; determine needed action. | P-2 |
| 13. | Perform on-engine inspections and tests on common rail type injection systems; determine needed action. | P-3 |
| 14. | Inspect high pressure injection lines, hold downs, fittings and seals; determine needed action. | P-3 |

H. Engine Brakes

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| 1. | Inspect and adjust engine compression/exhaust brakes; determine needed action. | P-3 |
| 2. | Inspect, test, and adjust engine compression/exhaust brake control circuits, switches, and solenoids; repair or replace as needed. | P-3 |
| 3. | Inspect engine compression/exhaust brake housing, valves, seals, lines, and fittings; repair or replace as needed. | P-3 |

DRIVE TRAIN

For every task in Drive Train, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Drive Train is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

II. DRIVE TRAIN

A. Clutch

1. Identify causes of clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action. P-1
2. 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. P-1
3. Inspect, adjust, repair, or replace hydraulic clutch slave and master cylinders, lines, and hoses; bleed system. P-2
4. Inspect, adjust, lubricate, or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals. P-1
5. Inspect, adjust, and replace single-disc clutch pressure plate and clutch disc. P-1
6. Inspect, adjust, and replace two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs. P-1
7. Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer; perform needed action. P-1
8. Inspect, adjust, and replace self-adjusting/continuous-adjusting clutch mechanisms. P-1
9. Inspect and replace pilot bearing. P-2

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| 10. | Inspect flywheel mounting area on crankshaft, rear main oil seal, and measure crankshaft end play; determine needed action. | P-2 |
| 11. | Inspect flywheel, starter ring gear and measure flywheel face and pilot bore runout; determine needed action. | P-2 |
| 12. | Inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action. | P-2 |

B. Transmission

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|-----|---|-----|
| 1. | Identify causes of transmission noise, shifting, lockup, jumping-out-of-gear, overheating, and vibration problems; determine needed action. | P-1 |
| 2. | Inspect, test, repair, or replace air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies. | P-2 |
| 3. | Inspect and replace transmission mounts, insulators, and mounting bolts. | P-1 |
| 4. | Inspect for leakage and replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; repair as needed. | P-1 |
| 5. | Check transmission fluid level and condition; determine needed service; add proper type of lubricant. | P-1 |
| 6. | Inspect, adjust, and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires. | P-2 |
| 7. | Remove and reinstall transmission. | P-1 |
| 8. | Inspect input shaft, gear, spacers, bearings, retainers, and slingers; determine needed action. | P-3 |
| 9. | Inspect transmission oil filters and coolers; replace as needed. | P-2 |
| 10. | Inspect speedometer components; determine needed action. | P-2 |
| 11. | Inspect and adjust power take-off (P.T.O.) assemblies, controls, and shafts; determine needed action. | P-3 |
| 12. | Inspect and test function of reverse light, neutral start, and warning device circuits; determine needed action. | P-1 |

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| 13. | Inspect and test transmission temperature gauge and sensor/sending unit; determine needed action. | P-2 |
| 14. | 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-2 |
| 15. | 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 | P-2 |
| 16. | 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. | P-1 |
| 17. | 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. | P-3 |
| 18. | Inspect and test operation of automatic transmission electronic shift selectors, switches, displays and indicators, wiring harnesses. | P-3 |
| 19. | 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. | P-3 |

C. Driveshaft and Universal Joint

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|----|--|-----|
| 1. | Identify causes of driveshaft and universal joint noise and vibration problems; determine needed action. | P-1 |
| 2. | 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. | P-1 |
| 3. | Inspect driveshaft center support bearings and mounts; determine needed action. | P-1 |
| 4. | Measure driveline angles; determine needed action. | P-2 |

D. Drive Axle

1. Identify causes of drive axle(s) drive unit noise and overheating problems; determine needed action. P-2
2. Check and repair fluid leaks; inspect and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals. P-1
3. Check drive axle fluid level and condition; determine needed service; add proper type of lubricant. P-1
4. Remove and replace differential carrier assembly. P-2
5. Inspect and replace differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearings. P-3
6. Inspect and replace components of locking differential case assembly. P-3
7. Inspect differential carrier housing and caps, side bearing bores, and pilot (spigot, pocket) bearing bore; determine needed action. P-3
8. Measure ring gear runout; determine needed action. P-3
9. Inspect and replace ring and drive pinion gears, spacers, sleeves, bearing cages, and bearings. P-3
10. Measure and adjust drive pinion bearing preload. P-3
11. Measure and adjust drive pinion depth. P-3
12. Measure and adjust side bearing preload and ring gear backlash. P-3
13. Check and interpret ring gear and pinion tooth contact pattern; determine needed action. P-3
14. Inspect, adjust, or replace ring gear thrust block/screw. P-3
15. Inspect power divider (inter-axle differential) assembly; determine needed action. P-3
16. 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. P-2

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| 17. | Inspect, repair, or replace drive axle lubrication system: pump, troughs, collectors, slingers, tubes, and filters. | P-3 |
| 18. | Inspect and replace drive axle shafts. | P-1 |
| 19. | Remove and replace wheel assembly; check rear wheel seal and axle flange gasket for leaks; perform needed action. | P-1 |
| 20. | Identify causes of drive axle wheel bearing noise and check for damage; perform needed action. | P-1 |
| 21. | Inspect and test drive axle temperature gauge and sending unit/sensor; determine needed action. | P-2 |
| 22. | Clean, inspect, lubricate and replace wheel bearings; replace seals and wear rings; inspect and replace retaining hardware; adjust drive axle wheel bearings. | P-1 |

BRAKES

For every task in Brakes, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Brakes is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

III. BRAKES

A. Air Brakes

1. Air Supply and Service Systems

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|----|--|-----|
| 1. | Identify poor stopping, air leaks, premature wear, pulling, grabbing, dragging, or balance problems caused by supply and service system malfunctions; determine needed action. | P-1 |
| 2. | Check air system build-up time; determine needed action. | P-1 |

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| 3. | Drain air reservoir/tanks; check for oil, water, and foreign material; determine needed action. | P-1 |
| 4. | Inspect compressor drive gear and coupling; replace as needed. | P-3 |
| 5. | Inspect air compressor inlet; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed. | P-2 |
| 6. | Inspect and test air system pressure controls: governor, unloader assembly valves, filters, lines, hoses, and fittings; adjust or replace as needed. | P-1 |
| 7. | Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed. | P-1 |
| 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. | P-1 |
| 9. | Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed. | P-1 |
| 10. | Inspect and test brake application (foot) valve, fittings, and mounts; check pedal operation; replace as needed. | P-1 |
| 11. | Inspect and test stop light circuit switches, wiring, and connectors; repair or replace as needed. | P-1 |
| 12. | Inspect and test hand brake (trailer) control valve, lines, fittings, and mountings; repair or replace as needed. | P-1 |
| 13. | Inspect and test brake relay valves; replace as needed. | P-1 |
| 14. | Inspect and test quick release valves; replace as needed. | P-1 |
| 15. | Inspect and test tractor protection valve; replace as needed. | P-1 |
| 16. | Inspect and test emergency (spring) brake control/modulator valve(s); replace as needed. | P-1 |
| 17. | Inspect and test low pressure warning devices, wiring, and connectors; repair or replace as needed. | P-1 |
| 18. | Inspect and test air pressure gauges, lines, and fittings; replace as needed. | P-2 |

2. Mechanical/Foundation

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

3. Parking Brakes

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|----|--|-----|
| 1. | Inspect and test parking (spring) brake chamber diaphragm and seals; replace parking (spring) brake chamber; dispose of removed chambers in accordance with local regulations. | P-1 |
| 2. | Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed. | P-1 |
| 3. | Inspect and test parking (spring) brake application and release valve; replace as needed. | P-2 |
| 4. | Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations. | P-1 |

B. Hydraulic Brakes

1. Hydraulic System

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|----|---|-----|
| 1. | Identify poor stopping, premature wear, pulling, dragging, balance, or pedal feel problems caused by the hydraulic system; determine needed action. | P-2 |
| 2. | Check brake pedal pushrod length; adjust as needed. | P-3 |
| 3. | Inspect and test master cylinder for internal/external leaks and damage; replace as needed. | P-2 |

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| 4. | Inspect hydraulic system brake lines, flexible hoses, and fittings for leaks and damage; replace as needed. | P-2 |
| 5. | Inspect and test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; replace as needed. | P-3 |
| 6. | Inspect and test brake pressure differential valve and warning light circuit switch, bulbs, wiring, and connectors; repair or replace as needed. | P-2 |
| 7. | Inspect disc brake caliper assemblies; replace as needed. | P-2 |
| 8. | Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type. | P-2 |

2. Mechanical/Foundation

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

3. Power Assist Units

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|----|---|-----|
| 1. | Identify stopping problems caused by the brake assist (booster) system; determine needed action. | P-3 |
| 2. | Inspect, test, repair, or replace hydraulic brake assist (booster), hoses, and control valves; determine proper fluid type. | P-3 |
| 3. | Check emergency (back-up, reserve) brake assist system. | P-3 |

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

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| 1. | Observe antilock brake system (ABS) warning light operation (includes dash mounted trailer ABS warning light); determine needed action. | P-1 |
| 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. | P-1 |
| 3. | Identify poor stopping and wheel lock-up problems caused by failure of the antilock brake system (ABS); determine needed action. | P-1 |
| 4. | Test and check operation of antilock brake system (ABS) air, hydraulic, electrical, and mechanical components; perform needed action. | P-1 |
| 5. | Test antilock brake system (ABS) wheel speed sensors and circuits; adjust or replace as needed. | P-1 |
| 6. | Bleed the ABS hydraulic circuits following manufacturers' procedures. | P-2 |
| 7. | Observe automatic traction control (ATC) warning light operation; determine needed action. | P-3 |
| 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. | P-3 |

D. Wheel Bearings

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|----|---|-----|
| 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. | P-1 |
| 2. | Inspect or replace extended service wheel bearing assemblies. | P-3 |

SUSPENSION AND STEERING

For every task in Suspension and Steering, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Suspension and Steering is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

IV. 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. P-1
2. Inspect and service steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft. P-1
3. Check and adjust cab mounting and ride height. P-3
4. Center the steering wheel as needed. P-1
5. Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' procedures. P-1

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. P-1
2. Determine recommended type of power steering fluid; check level and condition; determine needed action. P-1
3. Flush and refill power steering system; purge air from system. P-2
4. Perform power steering system pressure, temperature, and flow tests; P-2

determine needed action.

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| 5. | Inspect, service, or replace power steering reservoir including filter, seals, and gaskets. | P-2 |
| 6. | Inspect power steering pump drive gear and coupling; replace as needed. | P-3 |
| 7. | Inspect, adjust, or replace power steering pump, mountings, and brackets. | P-3 |
| 8. | Inspect and replace power steering system cooler, lines, hoses, clamps/mountings, hose routings, and fittings. | P-2 |
| 9. | Inspect, adjust, repair, or replace integral type power steering gear(s) (single and/or dual) and mountings. | P-1 |

3. Steering Linkage

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

B. Suspension Systems

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

needed.

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|-----|--|-----|
| 8. | Inspect air springs, mounting plates, springs, suspension arms, and bushings; replace as needed. | P-1 |
| 9. | Measure ride height; determine needed action. | P-1 |
| 10. | Identify rough ride problems; determine needed action. | P-3 |

C. Wheel Alignment Diagnosis, Adjustment, and Repair

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

D. Wheels and Tires

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

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

ELECTRICAL/ELECTRONIC SYSTEMS

For every task in Electrical/Electronic Systems, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Electrical/Electronic Systems is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

V. ELECTRICAL/ELECTRONIC SYSTEMS

A. General Electrical Systems

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|----|---|-----|
| 1. | Read and interpret electrical/electronic circuits using wiring diagrams. | P-1 |
| 2. | Check continuity in electrical/electronic circuits using appropriate test equipment. | P-1 |
| 3. | Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using appropriate test equipment. | P-1 |
| 4. | Check current flow in electrical/electronic circuits and components using appropriate test equipment. | P-1 |
| 5. | Check resistance in electrical/electronic circuits and components using | P-1 |

appropriate test equipment.

6. Locate shorts, grounds, and opens in electrical/electronic circuits. P-1
7. Identify parasitic (key-off) battery drain problems; perform tests; determine needed action. P-1
8. Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed. P-1
9. Inspect and test spike suppression devices; replace as needed. P-3
10. Check frequency and pulse width signal in electrical/electronic circuits using appropriate test equipment. P-3

B. Battery

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

C. Starting System

1. Perform starter circuit cranking voltage and voltage drop tests; determine needed action. P-1
2. Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed. P-2
3. Inspect and test, starter relays and solenoids/switches; replace as needed. P-2

4. Remove and replace starter; inspect flywheel ring gear or flex plate. P-2

D. Charging System Diagnosis and Repair

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

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. P-1
2. Identify causes of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation. P-1
3. Test, aim, and replace headlights. P-1
4. Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets, and control components/modules; repair or replace as needed. P-1

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|-----|---|-----|
| 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. | P-1 |
| 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. | P-2 |
| 7. | Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, wires, and control components/modules; repair or replace as needed. | P-2 |
| 8. | Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed. | P-1 |
| 9. | Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed. | P-1 |
| 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. | P-1 |
| 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. | P-2 |

F. Gauges and Warning Devices

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|----|---|-----|
| 1. | Interface with vehicle's on-board computer; perform diagnostic procedure using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action. | P-1 |
| 2. | Identify causes of intermittent, high, low, or no gauge readings; determine needed action. | P-2 |
| 3. | Identify causes of data bus-driven gauge malfunctions; determine needed action. | P-3 |
| 4. | Inspect and test gauge circuit sensor/sending units, gauges, connectors, terminals, and wires; repair or replace as needed. | P-2 |

- 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. P-2
- 6. Inspect, test, replace, and calibrate (if applicable) electronic speedometer, odometer, and tachometer systems. P-2

V. 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. P-1
- 2. Identify causes of constant, intermittent, or no horn operation; determine needed action. P-2
- 3. Inspect and test horn circuit relays, horns, switches, connectors, wires, and control components/modules; repair or replace as needed. P-2
- 4. Identify causes of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems; determine needed action. P-2
- 5. Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, wires and control components/modules; repair or replace as needed. P-2
- 6. Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed. P-2
- 7. Inspect and test windshield washer motor or pump/relay assembly, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed. P-3
- 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. P-3
- 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. P-3

10. Inspect and test auxiliary power outlet, integral fuse, connectors, terminals, wires, and control components/modules; repair or replace as needed. P-3
11. Identify causes of slow, intermittent, or no power side window operation; determine needed action. P-3
12. Inspect and test motors, switches, relays, connectors, terminals, wires, and control components/modules of power side window circuits; repair or replace as needed. P-3
13. Inspect and test block heaters; determine needed repairs. P-2
14. Inspect and test cruise control electrical components; repair or replace as needed. P-3
15. Inspect and test switches, relays, controllers, actuator/solenoids, connectors, terminals, and wires of electric door lock circuits. P-3
16. Check operation of keyless and remote lock/unlock devices; determine needed action. P-3
17. Inspect and test engine cooling fan electrical control components/modules; repair or replace as needed. P-2
18. Identify causes of data bus communication problems; determine needed action. P-2

HEATING, VENTILATION, & AIR CONDITIONING

For every task in Heating, Ventilation, and Air Conditioning, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Heating, Ventilation, & Air Conditioning is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

VI. HEATING, VENTILATION, & AIR CONDITIONING

All practices and procedures must be performed according to current mandates, standards, and regulations.

A. HVAC Systems

1. Verify the need for service or repair of HVAC systems based on unusual operating noises; determine needed action. P-1
2. Verify the need for service or repair of HVAC systems based on unusual visual, smell, and touch conditions; determine needed action. P-1
3. Identify system type and components (cycling clutch orifice tube – CCOT, expansion valve) and conduct performance test(s) on HVAC systems; determine needed action. P-1
4. Retrieve diagnostic codes; determine needed action. P-3

B. A/C System and Components

1. A/C System - General

1. Identify causes of temperature control problems in the A/C system; determine needed action. P-1
2. Identify refrigerant and lubricant types; check for contamination; determine needed action. P-1

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|----|--|-----|
| 3. | Identify A/C system problems indicated by pressure gauge and temperature readings; determine needed action. | P-1 |
| 4. | Identify A/C system problems indicated by visual, audible, smell, and touch procedures; determine needed action. | P-1 |
| 5. | Perform A/C system leak test; determine needed action. | P-1 |
| 6. | Recover, evacuate, and recharge A/C system using appropriate equipment. | P-1 |
| 7. | Identify contaminated A/C system components and hoses; determine needed action. | P-3 |

2. Compressor and Clutch

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|----|--|-----|
| 1. | Identify A/C system problems that cause protection devices (pressure, thermal, and electronic) to interrupt system operation; determine needed action. | P-1 |
| 2. | Inspect, test, and replace A/C system pressure, thermal, and electronic protection devices. | P-2 |
| 3. | Inspect and replace A/C compressor drive belts, pulleys, and tensioners; adjust belt tension and check alignment. | P-1 |
| 4. | Inspect, test, service, or replace A/C compressor clutch components or assembly. | P-2 |
| 5. | Inspect and correct A/C compressor lubricant level (if applicable). | P-2 |
| 6. | Inspect, test, or replace A/C compressor. | P-2 |
| 7. | Inspect, repair, or replace A/C compressor mountings and hardware. | P-2 |

3. Evaporator, Condenser, and Related Components

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| 1. | Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier, and hoses. | P-1 |
| 2. | Inspect A/C system hoses, lines, filters, fittings, and seals; determine needed action. | P-1 |
| 3. | Inspect A/C condenser for proper air flow. | P-1 |
| 4. | Inspect and test A/C system condenser and mountings; determine needed | P-2 |

action.

5. Inspect and replace receiver/drier or accumulator/drier. P-1
6. Inspect and test cab/sleeper refrigerant solenoid, expansion valve(s); check placement of thermal bulb (capillary tube); determine needed action. P-3
7. Remove and replace orifice tube. P-1
8. Inspect and test cab/sleeper evaporator core; determine needed action. P-3
9. Inspect, clean, or repair evaporator housing and water drain; inspect and service/replace evaporator air filter. P-1
10. Identify and inspect A/C system service ports (gauge connections); determine needed action. P-1
11. Identify the cause of system failures resulting in refrigerant loss from the A/C system high pressure relief device; determine needed action. P-2

C. Heating and Engine Cooling Systems

1. Identify causes of outlet air temperature control problems in the HVAC system; determine needed action. P-1
2. Identify window fogging problems; determine needed action. P-2
3. Perform engine cooling system tests for leaks, protection level, contamination, coolant level, coolant type, temperature, and conditioner concentration; determine needed action. P-1
4. Inspect engine cooling and heating system hoses, lines, and clamps; determine needed action. P-1
5. Inspect and test radiator, pressure cap, and coolant recovery system (surge tank); determine needed action. P-1
6. Inspect water pump for leaks and bearing play; determine needed action. P-2
7. Inspect and test thermostats, by-passes, housings, and seals; determine needed repairs. P-2
8. Recover, flush, and refill with recommended coolant/additive package; bleed cooling system. P-1
9. Inspect thermostatic cooling fan system (hydraulic, pneumatic, and P-2

electronic) and fan shroud; replace as needed.

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| 10. | Inspect and test heating system coolant control valve(s) and manual shut-off valves; determine needed action. | P-2 |
| 11. | Inspect and flush heater core; determine needed action. | P-3 |

D. Operating Systems and Related Controls

1. Electrical

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|----|--|-----|
| 1. | Identify causes of HVAC electrical control system problems; determine needed action. | P-1 |
| 2. | Inspect and test HVAC blower motors, resistors, switches, relays, modules, wiring, and protection devices; determine needed action. | P-2 |
| 3. | Inspect and test A/C compressor clutch relays, modules, wiring, sensors, switches, diodes, and protection devices; determine needed action. | P-2 |
| 4. | Inspect and test A/C related electronic engine control systems; determine needed action. | P-2 |
| 5. | Inspect and test engine cooling/condenser fan motors, relays, modules, switches, sensors, wiring, and protection devices; determine needed action. | P-2 |
| 6. | Inspect and test electric actuator motors, relays/modules, switches, sensors, wiring, and protection devices; determine needed action. | P-3 |
| 7. | Inspect and test HVAC system electrical/electronic control panel assemblies; determine needed action. | P-3 |

2. Air/ Mechanical

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|----|--|-----|
| 1. | Identify causes of HVAC air and mechanical control problems; determine needed action. | P-3 |
| 2. | Inspect and test HVAC system air and mechanical control panel assemblies; determine needed action. | P-3 |
| 3. | Inspect, test, and adjust HVAC system air and mechanical control cables and linkages; determine needed action. | P-3 |
| 4. | Inspect and test HVAC system actuators and hoses; determine needed | P-3 |

action.

5. Inspect, test, and adjust HVAC system ducts, doors, and outlets; determine needed action. P-3

E. Refrigerant Recovery, Recycling, and Handling

NOTE: Tasks 1 through 5 should be accomplished in accordance with appropriate EPA regulations and SAE “J” standards.

1. Maintain and verify correct operation of certified equipment. P-1
2. Identify and recover A/C system refrigerant. P-1
3. Recycle or properly dispose of refrigerant. P-1
4. Handle, label, and store refrigerant. P-1
5. Test recycled refrigerant for non-condensable gases. P-1

PREVENTIVE MAINTENANCE AND INSPECTION

For every task in Preventive Maintenance and Inspection, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The tasks included in the Preventive Maintenance and Inspection area are entry-level technician inspection tasks designed to introduce the student to correct procedures and practices of vehicle inspection in a teaching/learning environment. They are not intended to satisfy the Annual Federal Vehicle Inspection requirement as prescribed in the *Federal Motor Carrier Safety Regulations, Part 396, Appendix G to Subchapter B, Minimum Periodic Inspection Standards*.

The first task in Preventive Maintenance is to listen to and verify operator's concern, review past maintenance documents, and record condition on appropriate document.

VII. PREVENTIVE MAINTENANCE and INSPECTION

A. Engine System

1. Engine

1. Check engine starting/operation (including unusual noises, vibrations, exhaust smoke, etc.); record idle and governed rpm. P-1
2. Inspect vibration damper. P-1
3. Inspect belts, tensioners, and pulleys; check and adjust belt tension; check belt alignment. P-1
4. Check engine oil level and condition; check dipstick seal. P-1
5. Inspect engine mounts for looseness and deterioration. P-1
6. Check engine for oil, coolant, air, fuel, and exhaust leaks (Engine Off and Running). P-1
7. Check engine compartment wiring harnesses, connectors, and seals for damage and proper routing. P-1

2. Fuel System

1. Check fuel tanks, mountings, lines, caps, and vents. P-1
2. Drain water from fuel system. P-1
3. Service water separator/fuel heater; replace fuel filter(s); prime and bleed fuel system. P-1

3. Air Induction and Exhaust System

1. Check exhaust system mountings for looseness and damage. P-1
2. 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. P-1
3. Check air induction system: piping, charge air cooler, hoses, clamps, and mountings; check for air restrictions and leaks. P-1
4. Inspect turbocharger for leaks; check mountings and connections. P-1
5. Check operation of engine compression/exhaust brake. P-1
6. Service or replace air filter as needed; check and reset air filter restriction indicator. P-1
7. Inspect and service crankcase ventilation system. P-1

4. Cooling System

1. Check operation of fan clutch. P-1
2. Inspect radiator (including air flow restriction, leaks, and damage) and mountings. P-1
3. Inspect fan assembly and shroud. P-1
4. Pressure test cooling system and radiator cap. P-1
5. Inspect coolant hoses and clamps. P-1
6. Inspect coolant recovery system. P-1

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| 7. | Check coolant for contamination, additive package concentration, and protection level (freeze point). | P-1 |
| 8. | Service coolant filter. | P-1 |
| 9. | Inspect water pump for leaks and bearing play. | P-1 |

5. Lubrication System

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| 1. | Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs. | P-1 |
| 2. | Take an engine oil sample. | P-1 |

B. Cab and Hood

1. Instruments and Controls

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| 1. | Inspect key condition and operation of ignition switch. | P-1 |
| 2. | Check warning indicators. | P-1 |
| 3. | Check instruments; record oil pressure and system voltage. | P-1 |
| 4. | Check operation of electronic power take off (PTO) and engine idle speed controls (if applicable). | P-1 |
| 5. | Check HVAC controls. | P-1 |
| 6. | Check operation of all accessories. | P-1 |
| 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). | P-1 |

2. Safety Equipment

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|----|--|-----|
| 1. | Check operation of electric/air horns and reverse warning devices. | P-1 |
| 2. | Check condition of spare fuses, triangles, fire extinguisher, and all required decals. | P-1 |
| 3. | Inspect seat belts and sleeper restraints. | P-1 |
| 4. | Inspect wiper blades and arms. | P-1 |

3. Hardware

1. Check operation of wiper and washer. P-1
2. Inspect windshield glass for cracks or discoloration; check sun visor. P-1
3. Check seat condition, operation, and mounting. P-1
4. Check door glass and window operation. P-1
5. Inspect steps and grab handles. P-1
6. Inspect mirrors, mountings, brackets, and glass. P-1
7. Record all observed physical damage. P-1
8. Lubricate all cab and hood grease fittings. P-1
9. Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables. P-1
10. Inspect cab mountings, hinges, latches, linkages and ride height; service as needed. P-1

4. Heating, Ventilation, & Air Conditioning (HVAC)

1. Inspect A/C condenser and lines for condition and visible leaks; check mountings. P-1
2. Inspect A/C compressor and lines for condition and visible leaks; check mountings. P-1
3. Check A/C system condition and operation; check A/C monitoring system, if applicable. P-1
4. Check HVAC air inlet filters and ducts; service as needed. P-1

C. Electrical/Electronics

1. Battery and Starting Systems

1. Inspect battery box(es), cover(s), and mountings. P-1
2. Inspect battery hold-downs, connections, cables, and cable routing; service as needed. P-1

3. Check/record battery state-of-charge (open circuit voltage) and condition. P-1
4. Perform battery test (load and/or capacitance). P-1
5. Inspect starter, mounting, and connections. P-1
6. Engage starter; check for unusual noises, starter drag, and starting difficulty. P-1

2. Charging System

1. Inspect alternator, mountings, cable, wiring, and wiring routing; determine needed action. P-1
2. Perform alternator output tests. P-1

3. Lighting System

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

D. Frame and Chassis

1. Air Brakes

1. Check operation of parking brake. P-1
2. Record air governor cut-out setting (psi). P-1
3. Check operation of air reservoir/tank drain valves. P-1
4. Check air system for leaks (brakes released). P-1
5. Check air system for leaks (brakes applied). P-1
6. Test one-way and double-check valves. P-1
7. Check low air pressure warning devices. P-1
8. Check air governor cut-in pressure. P-1

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| 9. | Check emergency (spring) brake control/modulator valve, if applicable. | P-1 |
| 10. | Check tractor protection valve. | P-1 |
| 11. | Test air pressure build-up time. | P-1 |
| 12. | Inspect coupling air lines, holders, and gladhands. | P-1 |
| 13. | Check brake chambers and air lines for secure mounting and damage. | P-1 |
| 14. | Check operation of air drier. | P-1 |
| 15. | Inspect and record brake shoe/pad condition, thickness, and contamination. | P-1 |
| 16. | Inspect and record condition of brake drums/rotors. | P-1 |
| 17. | Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing. | P-1 |
| 18. | Check operation and adjustment of brake automatic slack adjusters (ASA); check and record push rod stroke. | P-1 |
| 19. | Lubricate all brake component grease fittings. | P-1 |
| 20. | Check condition and operation of hand brake (trailer) control valve. | P-1 |
| 21. | Perform antilock brake system (ABS) operational system self-test. | P-1 |
| 22. | Drain air tanks and check for contamination. | P-1 |
| 23. | Check condition of pressure relief (safety) valves. | P-1 |

2. Hydraulic Brakes

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| 1. | Check master cylinder fluid level and condition. | P-1 |
| 2. | Inspect brake lines, fittings, flexible hoses, and valves for leaks and damage. | P-1 |

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| 3. | Check parking brake operation; inspect parking brake application and holding devices; adjust as needed. | P-1 |
| 4. | Check operation of hydraulic system: pedal travel, pedal effort, pedal feel (drift). | P-1 |
| 5. | Inspect calipers for leakage and damage. | P-1 |
| 6. | Inspect brake assist system (booster), hoses and control valves; check reservoir fluid level and condition. | P-1 |
| 7. | Inspect and record brake lining/pad condition, thickness, and contamination. | P-1 |
| 8. | Inspect and record condition of brake rotors. | P-1 |
| 9. | Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing. | P-1 |

3. Drive Train

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| 1. | Check operation of clutch, clutch brake, and gearshift. | P-1 |
| 2. | Check clutch linkage/cable for looseness or binding, if applicable. | P-1 |
| 3. | Check hydraulic clutch slave and master cylinders, lines, fittings, and hoses, if applicable. | P-1 |
| 4. | Check clutch adjustment; adjust as needed. | P-1 |
| 5. | Check transmission case, seals, filter, hoses, and cooler for cracks and leaks. | P-1 |
| 6. | Inspect transmission breather. | P-1 |
| 7. | Inspect transmission mounts. | P-1 |
| 8. | Check transmission oil level, type, and condition. | P-1 |
| 9. | Inspect U-joints, yokes, driveshafts, boots/seals, center bearings, and mounting hardware for looseness, damage, and proper phasing. | P-1 |
| 10. | Inspect axle housing(s) for cracks and leaks. | P-1 |
| 11. | Inspect axle breather(s). | P-1 |

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| 12. | Lubricate all drive train grease fittings. | P-1 |
| 13. | Check drive axle(s) oil level, type, and condition. | P-1 |
| 14. | Change drive axle(s) oil and filter; check and clean magnetic plugs. | P-1 |
| 15. | Check transmission wiring, connectors, seals, and harnesses for damage and proper routing. | P-1 |
| 16. | Change transmission oil and filter; check and clean magnetic plugs. | P-1 |
| 17. | Check interaxle differential lock operation. | P-1 |
| 18. | Check range shift operation. | P-1 |

4. Suspension and Steering Systems

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| 1. | Check steering wheel operation for free play or binding. | P-1 |
| 2. | Check power steering pump, mounting, and hoses for leaks, condition, and routing; check fluid level. | P-1 |
| 3. | Change power steering fluid and filter. | P-1 |
| 4. | Inspect steering gear for leaks and secure mounting. | P-1 |
| 5. | Inspect steering shaft U-joints, pinch bolts, splines, pitman arm-to-steering sector shaft, tie rod ends, and linkages. | P-1 |
| 6. | Check kingpin for wear. | P-1 |
| 7. | Check wheel bearings for looseness and noise. | P-1 |
| 8. | Check oil level and condition in all non-drive hubs; check for leaks. | P-1 |
| 9. | Inspect springs, pins, hangers, shackles, spring U-bolts, and insulators. | P-1 |
| 10. | Inspect shock absorbers for leaks and secure mounting. | P-1 |
| 11. | Inspect air suspension springs, mounts, hoses, valves, linkage, and fittings for leaks and damage. | P-1 |
| 12. | Check and record suspension ride height. | P-1 |
| 13. | Lubricate all suspension and steering grease fittings. | P-1 |

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| 14. | Check toe setting. | P-1 |
| 15. | Check tandem axle alignment and spacing. | P-1 |
| 16. | Check axle locating components (radius, torque, and/or track rods). | P-1 |

5. Tires and Wheels

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| 1. | Inspect tires for wear patterns and proper mounting. | P-1 |
| 2. | Inspect tires for cuts, cracks, bulges, and sidewall damage. | P-1 |
| 3. | Inspect valve caps and stems; replace as needed. | P-1 |
| 4. | Measure and record tread depth; probe for imbedded debris. | P-1 |
| 5. | Check and record air pressure; adjust air pressure in accordance with manufacturers' specifications. | P-1 |
| 6. | Check for loose lugs; check mounting hardware condition; service as needed. | P-1 |
| 7. | Retorque lugs in accordance with manufacturers' specifications. | P-1 |
| 8. | Inspect wheels for cracks or damage. | P-1 |
| 9. | Check tire matching (diameter and tread) on dual tire installations. | P-1 |

6. Frame and Fifth Wheel

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| 1. | Inspect fifth wheel mounting, bolts, air lines, and locks. | P-1 |
| 2. | Test operation of fifth wheel locking device; adjust if necessary. | P-1 |
| 3. | Check quarter fenders, mud flaps, and brackets. | P-1 |
| 4. | Check pintle hook assembly and mounting. | P-1 |
| 5. | Lubricate all fifth wheel grease fittings and plate. | P-1 |
| 6. | Inspect frame and frame members for cracks and damage. | P-1 |

HYDRAULICS

For every task in Hydraulics, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Hydraulics is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

VIII. HYDRAULICS

A. General System Operation

1. Identify system type (closed and open) and verify proper operation. P-1
2. Read and interpret system diagrams and schematics. P-1
3. Perform system temperature, pressure, flow, and cycle time tests; determine needed action. P-1
4. Verify placement of equipment /component safety labels and placards; determine needed action. P-1

B. Pumps

1. Identify system fluid type. P-1
2. Identify causes of pump failure, unusual pump noises, temperature, flow, and leakage problems; determine needed action. P-2
3. Determine pump type, rotation, and drive system. P-2
4. Remove and install pump; prime and/or bleed system. P-2
5. Inspect pump inlet for restrictions and leaks; determine needed action. P-2
6. Inspect pump outlet for restrictions and leaks; determine needed action. P-2

C. Filtration/ Reservoirs (Tanks)

1. Identify type of filtration system; verify filter application and flow direction. P-1
2. Service filters and breathers. P-1
3. Identify causes of system contamination; determine needed action. P-2
4. Take a hydraulic oil sample. P-2

- 5. Check reservoir fluid level and condition; determine needed action. P-1
- 6. Inspect and repair or replace reservoir, sight glass, vents, caps, mounts, valves, screens, supply and return lines. P-2

D. Hoses, Fittings, and Connections

- 1. Diagnose causes of component leakage, damage, and restriction; determine needed action. P-2
- 2. Inspect hoses and connections (length, size, routing, bend radii, and protection); repair or replace as needed. P-1
- 3. Assemble hoses, tubes, connectors, and fittings in accordance with manufacturers' specifications; use proper procedures to avoid contamination. P-2
- 4. Inspect and replace fitting seals and sealants. P-2

E. Control Valves

- 1. Pressure test system safety relief valve; determine needed action. P-2
- 2. Perform control valve operating pressure and flow tests; determine needed action. P-2
- 3. Inspect, test, and adjust valve controls (electrical/electronic, mechanical, and pneumatic). P-2
- 4. Identify causes of control valve leakage problems (internal/external); determine needed action. P-2
- 5. Inspect pilot control valve linkages, cables, and PTO controls; adjust, repair, or replace as needed. P-1

F. 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.

1. Identify actuator type (single/double acting, multi-stage/telescopic, and motors).. P-1
2. Identify the cause of seal failure; determine needed repairs. P-2
3. Identify the cause of incorrect actuator movement and leakage (internal and external); determine needed repairs. P-2
4. Inspect actuator mounting, frame components, and hardware for looseness, cracks, and damage; determine needed action. P-2
5. Remove, repair, and/or replace actuators in accordance with manufacturers' recommended procedures. P-2
6. Inspect actuators for dents, cracks, damage, and leakage; determine needed action. P-2
7. Purge and/or bleed system in accordance with manufacturers' recommended procedures. P-1

Task List Priority Item Totals (by area)

<p>I. Diesel Engines</p> <p style="padding-left: 20px;">P-1 = 39 95% = 37 tasks</p> <p style="padding-left: 20px;">P-2 = 26 70% = 18 tasks</p> <p style="padding-left: 20px;">P-3 = 24 25% = 6 tasks</p>	<p>V. Electrical/Electronic Systems</p> <p style="padding-left: 20px;">P-1 = 31 95% = 29 tasks</p> <p style="padding-left: 20px;">P-2 = 21 70% = 15 tasks</p> <p style="padding-left: 20px;">P-3 = 12 25% = 3 tasks</p>
<p>II. Drive Train</p> <p style="padding-left: 20px;">P-1 = 23 95% = 22 tasks</p> <p style="padding-left: 20px;">P-2 = 17 70% = 12 tasks</p> <p style="padding-left: 20px;">P-3 = 17 25% = 4 tasks</p>	<p>VI. Heating, Ventilation, & Air Conditioning</p> <p style="padding-left: 20px;">P-1 = 29 95% = 28 tasks</p> <p style="padding-left: 20px;">P-2 = 16 70% = 11 tasks</p> <p style="padding-left: 20px;">P-3 = 12 25% = 3 tasks</p>
<p>III. Brakes</p> <p style="padding-left: 20px;">P-1 = 30 95% = 29 tasks</p> <p style="padding-left: 20px;">P-2 = 14 70% = 10 tasks</p> <p style="padding-left: 20px;">P-3 = 10 25% = 3 tasks</p>	<p>VII. Preventative Maintenance Inspection</p> <p style="padding-left: 20px;">P-1 = 145 95% = 138 tasks</p> <p style="padding-left: 20px;">P-2 = 0</p> <p style="padding-left: 20px;">P-3 = 0</p>
<p>IV. Suspension & Steering</p> <p style="padding-left: 20px;">P-1 = 23 95% = 22 tasks</p> <p style="padding-left: 20px;">P-2 = 11 70% = 8 tasks</p> <p style="padding-left: 20px;">P-3 = 11 25% = 3 tasks</p>	<p>VIII. Hydraulics</p> <p style="padding-left: 20px;">P-1 = 12 95% = 11 tasks</p> <p style="padding-left: 20px;">P-2 = 20 70% = 14 tasks</p> <p style="padding-left: 20px;">P-3 = 0</p>