
**APPLIED ACADEMIC &
WORKPLACE SKILLS
FOR
COLLISION REPAIR & REFINISH
TECHNICIANS**



**National Automotive Technicians Education Foundation (NATEF)
101 Blue Seal Drive, S.E., Suite 101
Leesburg, Virginia 20175**

(703) 669-6650

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*** With 2009 Collision Repair & Refinish Task List**

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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 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 Collision Repair and Refinish 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 two different sites around the country where a high concentration of ASE Certified technicians lived and worked. Once these sites were identified, Dr. Lundquist then worked with local teachers and contacts in the autobody industry to identify the names of outstanding ASE Certified 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 five specialty areas existed within the NATEF Collision Repair and Refinish Task List, the decision was made to treat the total collision repair and refinish technician task list as follows:

MEETING SITES AND SPECIALTIES ADDRESSED

Meeting No.	Location	Specialties
1	Fort Lauderdale, Florida	<ul style="list-style-type: none"> • Structural Analysis and Damage Repair • Non-Structural Analysis and Damage Repair
2	Pittsburgh, Pennsylvania	<ul style="list-style-type: none"> • Mechanical and Electrical Components • Plastic Repair • Painting and Refinishing

TECHNICIANS WHO PARTICIPATED IN EACH MEETING

Meeting Location	Participants		
Fort Lauderdale, Florida	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <p>Mr. Ridel Gomez Airport Body Shop 3020 South Federal Highway Ft. Lauderdale, FL 33316</p> <p>Mr. Steve Wood Body Shop Manager Ft. Lauderdale Nissan 122 Southwest 22nd Street Ft. Lauderdale, FL 33316</p> </td> <td style="width: 50%; border: none;"> <p>Mr. Mike Setzer Instructor, Sheridan Vo-Tech 5400 Sheridan Street Hollywood, FL 33021</p> </td> </tr> </table>	<p>Mr. Ridel Gomez Airport Body Shop 3020 South Federal Highway Ft. Lauderdale, FL 33316</p> <p>Mr. Steve Wood Body Shop Manager Ft. Lauderdale Nissan 122 Southwest 22nd Street Ft. Lauderdale, FL 33316</p>	<p>Mr. Mike Setzer Instructor, Sheridan Vo-Tech 5400 Sheridan Street Hollywood, FL 33021</p>
<p>Mr. Ridel Gomez Airport Body Shop 3020 South Federal Highway Ft. Lauderdale, FL 33316</p> <p>Mr. Steve Wood Body Shop Manager Ft. Lauderdale Nissan 122 Southwest 22nd Street Ft. Lauderdale, FL 33316</p>	<p>Mr. Mike Setzer Instructor, Sheridan Vo-Tech 5400 Sheridan Street Hollywood, FL 33021</p>		

Pittsburgh, Pennsylvania	Mr. Dennis Moffa Body Shop Manager Ted McWilliams Toyota City 3475 William Penn Highway Pittsburgh, PA 15235	Mr. John Opeka 440 Valley Brook Road McMurry, PA 15317
	Mr. Johnny R. Mock Johnny Mock's CARSTAR 1271 Rodi Road Turtle Creek, PA 15145	Mr. Ed Gibson Gibson CARSTAR Body Works 243 East Main Street Monongahela, PA 15063
	Mr. Dan Frohlich ARS Automotive 405 Davidson Road Pittsburgh, PA 15239	Mr. Dale Williams Rt. 2, Box 145, 11 A Saltsburg, PA 15681
	Mr. Fran Roberts Roberts CARSTAR Auto Body P. O. Box 503 Fayette City, PA 15438	Mr. Ralph Paga 1492 Maple Avenue Glenshaw, PA 15116
	Mr. John Warabow 101 Colonial Way Cannonsburg, PA 15317	Mr. Pete Kozak 660 Linden Avenue Johnstown, PA 15902
		Mr. Joe Masollo 2418 Wolford Street Pittsburgh, PA 15226

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 two collision repair and refinish 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. Chrysendra Spiceland, Language Arts; and Dr. Trina Boteler, Science. The process involved taking each of the tasks in each of the five 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 database. 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 Collision Repair and Refinish.

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 five specialty lists that were specific to each of the five areas. A matrix was then built showing the relationship between the composite list and each of the five 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 Collision Repair and Refinish 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
COLLISION REPAIR AND REFINISH TECHNICIANS
RELATED ACADEMIC SKILLS COMMITTEE
FROM THE V-TECS/ILLINOIS WORKPLACE SKILLS LIST

A. DEVELOPING AN EMPLOYMENT PLAN

1. Match aptitudes and interest to employment area.
2. Match attitudes to a job area.
3. Match personality type to 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. Locate resources for finding employment.
4. Prepare a resume.
5. Identify conditions for employment.
6. Evaluate job opportunities.
7. Identify steps in applying for a job.
8. Complete job application form.
9. Identify attire for job interview.

C. ACCEPTING EMPLOYMENT

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

D. COMMUNICATING ON THE JOB

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

E. INTERPRETING THE ECONOMICS OF WORK

1. Describe responsibilities of employee.
2. Describe responsibilities of employer or management.
3. Investigate opportunities and options for business ownership.
4. Assess entrepreneurial skills.

F. MAINTAINING PROFESSIONALISM

1. Assess business image and products/services.
2. Identify positive behavior.
3. Identify company dress and appearance standards.
4. Participate in meetings.
5. Identify work-related terminology.
6. Identify how to treat people with respect.

G. ADAPTING/COPING WITH CHANGE

1. Identify the elements of the job transition.
2. Formulate transition plan.
3. Exhibit ability to handle stress.
4. Recognize need to change or quit a job.
5. Write a letter of resignation.

H. SOLVING PROBLEMS AND CRITICAL THINKING

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

I. MAINTAINING SAFE AND HEALTHY ENVIRONMENT

1. Identify safety and health rules/procedures.
2. Demonstrate the knowledge of equipment in the work place.
3. Identify conservation and environmental practices and policies.
4. Act during emergencies.
5. Maintain work area.
6. Identify hazardous substances in the work place.

J. DEMONSTRATING WORK ETHICS AND BEHAVIOR

1. Identify established rules, regulations and policies.
2. Practice cost effectiveness.
3. Practice time management.
4. Assume responsibility for decisions and actions.
5. Exhibit pride.
6. Display initiative.
7. Demonstrate willingness to learn.
8. Identify the value of maintaining regular attendance.
9. Apply ethical reasoning.

K. DEMONSTRATING TECHNOLOGY LITERACY

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

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.

M. DEMONSTRATING TEAM WORK

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.

Workplace Skills
8

5. Evaluate outcomes.

**NARRATIVE FOR LANGUAGE ARTS RELATED ACADEMIC SKILLS
for all
NATEF Collision Repair and Refinish Technician Task Lists**

The collision repair and refinish 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 problem 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 specific problems.
- 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 systems and components of the automobile and light truck.
- 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 and databases 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, operations, and potential malfunctions.
- Interpret charts, tables, or graphs to determine the manufacturer's specifications for systems operation to identify out-of-tolerance systems and subsystems.
- Supply clarifying information to customers, associates, parts suppliers, and supervisors.

NARRATIVE FOR MATHEMATICS RELATED ACADEMIC SKILLS
for all
NATEF Collision Repair and Refinish Technician Task Lists

The collision repair and refinish 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 that are needed to arrive at a solution that can be compared to other specifications when comparing system measurements or tolerances 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.
- Subtract whole numbers, fractions, or decimals to arrive at a difference for comparison with the manufacturer's specifications.
- Multiply whole numbers, fractions, or decimals to arrive at a solution for comparison with the manufacturer's specifications.
- Divide decimals to determine measurement conformance with the manufacturer's specifications.
- Convert variables presented orally to a mathematical form that allows 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, lubricant, compound, or finish material.
- 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 parallel lines, perpendicular lines, and angle variances from the manufacturer's specifications.
- Solve problems that involve determining the relative proportion of the 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 component or system being analyzed and repaired.
- 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 under review.
- 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 measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle components requiring geometric alignment.
- Use formulas to indirectly confirm that systems 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.
- Formulate an angle visually and verify conformance to the manufacturer's specified angle.
- Measure timed or sequenced parameters to determine conformance with the manufacturer's specifications.
- Use English and metric scales to determine the conformance of components to the manufacturer's specified weight.
- 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 or mixture 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.

NARRATIVE FOR SCIENCE RELATED ACADEMIC SKILLS
for all
NATEF Collision Repair and Refinish Technician Task Lists

The collision repair and refinish 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, graphs, or databases to determine manufacturer's specifications for system(s) operation(s) and the appropriate repair/replacement part and/or 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.
- Demonstrate an understanding of the chemical reaction that occurs in various compounds and substances used in the automobile.
- Explain the role an additive or catalyst plays in the mixing of fillers or finishes for use on the automobile body.
- Describe and explain the role that pigmentation plays in determining the specific shade of an automobile body or interior component color.
- Demonstrate an understanding of the total color spectrum by explaining the roles different colors play in different mixtures and finishes.
- Explain how various forms of energy are dissipated throughout the body based on the momentum of the vehicle at the time of impact.
- Explain the principles of force as it applies to the realignment of components.
- Demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating vehicle assemblies.
- Explain how the velocity of an object in motion impacts on another object.

- Explain how the rate of a force in motion can impact on an automobile body.
- Demonstrate an understanding of the concept of pressure in relation to the concept of using force to realign a component.
- Explain the concept of heat transfer in terms of conduction, convection, and radiation in various automotive systems.
- Demonstrate an understanding of the expansion and contraction of system parts as a result of heat generated during use and the cooling down 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 changing a solid to a liquid to a gas.
- Explain the role of insulation in maintaining stable temperatures or preventing the transfer of heat to an unwanted area.
- Explain the difference between heat and temperature and demonstrate an understanding of how to measure each in different situations.
- Explain how the angle or amount of light can impact on the appearance of a given finish in terms of texture and quality of finish.
- Explain color and shades of color based on how light hits or passes through it.
- Explain the difference between the principles of translucent light (diffuses) as contrasted to transparent light (passes through).
- Explain how ultraviolet rays can cause a finish or substance to deteriorate.
- Demonstrate an understanding of refraction in fiber optic systems.
- Explain that dyes added to fluids fluoresce under ultraviolet light and provide a process for determining the source of leakage in a system.
- Explain in detail the three states of matter.
- 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 and engine can be carried to other parts of the engine through metal and 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 perceived intensity to decibel level of a noise.

- Demonstrate an understanding of the types of vibrations caused by out-of-balance or excessively worn systems.
- Explain and demonstrate an understanding of the role of listening to sounds as part of the troubleshooting process.
- Explain that the presence of overtones may indicate changes in the vibrations of various systems.
- Demonstrate an understanding of and discuss relative humidity in terms of effect on paint and substance applications.
- Explain how levers and pulleys can be used to increase an applied force or distance.
- Identify the effect of the pH of a solution on chemical changes in a system.
- Identify the characteristics that define a component or system that is operating within the manufacturer's specifications.
- Use precision measuring devices to determine if replaced components are within the manufacturer's specifications, and to assure that repair or replacement parts meet the manufacturer's specifications.
- Use tension gauges, such as 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 in order to mix an adhesive or to determine the strength and integrity of a component or part.
- Use pressure measuring tools to determine pressures in hydraulic or pneumatic paint 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 for proper cure and application times.
- Use direct and indirect methods to measure application times and compare the results to the manufacturer's specifications.
- Use direct and indirect methods to measure the volume of liquids in a mixture or compound.
- 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 to the customer the need for lubrication of adjacent parts to minimize friction as a result of movement at the junction of the parts.
- Explain the criticality of metals with different hardness, depending on the function and location of the metal as well as how fillers and finishes adhere to metal.

- Explain the necessity of knowing that the hardness of a metal determines, in part, its function and location in the automobile.
- 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 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 will effect operation of pneumatic tools and equipment.
- Explain the dynamic control properties of a hydraulic system in terms of its impact on spray patterns, volume, etc.
- Explain the surface process that occurs on system seals due to absorption of the contained materials.
- Demonstrate an understanding of how a contaminated liquid can cause a chemical reaction which can result in the deterioration of the finish or a plastic component.
- Use precision gauges or instruments to measure the flow rate of air in a painting application.
- Demonstrate an understanding of how variances in flow rate can effect the spray patters, thickness of coat, etc., in the finishing process.
- Correctly use proportions and ratios in mixing fillers, finishes, and other substances.
- Explain the role that acids and bases have in altering compounds used on or in the automobile.
- Understand the use and safety requirements of all solvents used in an automotive application.
- Demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.
- Identify the physical properties of an automobile component or system that are made of glass or plastic.
- Describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.
- Explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

- Locate and explain the properties of a given source of light.

Electrical/Tolerances

- Explain and demonstrate an understanding of the properties of electricity that impact the lighting, engine management, and other electrical systems in the vehicle.
- 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.
- Demonstrate an understanding of the role of solar panels in maintaining battery voltage and operating selected accessories.
- 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, resistance, or power.
- 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 ion transfer process that occurs in an automotive battery.
- Explain the effect of oxidation on electrical connections as well as on an automotive finish.
- Explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.
- Explain how attaching magnets to an automobile body can cause paint to be evenly distributed through the principles of magnetism.

- 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 FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
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	●	●	●	●	●

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE LANGUAGE ARTS/COMMUNICATIONS SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
LA098	Composes/Edits Report Summaries	●	●	●	●	●
LA099	Composes/Edits Sentences	●	●	●	●	●
LA121	Comprehends Information-Oral	●	●	●	●	●
LA132	Comprehends Information-Written	●	●	●	●	●
LA134	Comprehends Information-Written Cause/Effect Relationships	●	●	●	●	●
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	●	●	●	●	●
LA266	Presents Informal Speech Information Requests	●	●	●	●	●

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE LANGUAGE ARTS/COMMUNICATIONS SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
LA267	Presents Informal Speech Information Supplying	●	●	●	●	●
LA271	Uses Dictionary	●	●	●	●	●
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 Collision Repair and Refinish 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 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 automobile.
- 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.
- 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 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 for clarity and adequacy 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.
- 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.
- LA271 Uses Dictionary
-The technician refers to the dictionary to define terms or to check spelling.
- 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 automotive and autobody 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.

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE MATH SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
MA001	Calculates/Evaluates Algebraic Expressions			●		
MA013	Calculates/Evaluates Mean/Median/Mode	●	●	●		
MA014	Calculates/Evaluates Measurement Precision	●		●		
MA026	Computes Addition Decimals	●	●	●		●
MA028	Computes Addition Mentally	●	●	●	●	●
MA034	Computes Addition Whole Numbers	●	●	●	●	●
MA039	Computes Division Decimals	●	●	●	●	●
MA047	Computes Division Whole Numbers	●	●	●	●	●
MA065	Computes Multiplication Decimals	●	●	●	●	●
MA067	Computes Multiplication Mentally	●	●	●	●	●
MA073	Computes Subtraction Whole Numbers	●	●	●	●	●
MA084	Computes Subtraction Decimals	●	●	●	●	●
MA086	Computes Subtraction Mentally	●	●	●	●	●
MA092	Computes Subtraction Whole Numbers	●	●	●	●	●
MA126	Converts Units English/Metric -- Feet/Meters	●	●	●	●	●
MA128	Distinguishes Angles/Circles/Arcs	●		●		
MA129	Distinguishes Congruence/Similarity Geometric Figures	●		●		

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE MATH SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
MA131	Distinguishes Equal/Not Equal	●		●		
MA132	Distinguishes Estimate/Exact Value	●				
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	●	●	●		
MA170	Identifies Lines Vertical/Horizontal	●	●	●		
MA171	Identifies Metric Measures Length/Volume/Weight	●	●	●	●	●
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		●		●	●

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE MATH SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
MA184	Measures Direct Volume			●		
MA185	Measures Direct Weight		●			
MA186	Measures Indirect	●	●	●	●	●
MA190	Measures Metric Distance	●	●	●	●	●
MA191	Measures Metric Temperature					●
MA192	Measures Metric Volume	●	●		●	●
MA193	Measures Metric Weight					●
MA229	Solves Problems Generates Conclusions Deductive Reasoning			●		
MA239	Understands Conditionals	●		●		
MA242	Understands Definitions Standards	●	●	●	●	●
MA244	Understands Geometric Figures Visual Perception	●	●	●		
MA245	Understands Line/Angle Relationships	●	●	●	●	
MA271	Determines Proper Operation	●	●	●	●	●
MA273	Computes Tolerances/Ranges Mentally	●	●	●	●	●
MA274	Computes Proper Operations Mentally	●	●	●	●	●
MA275	Identifies Temperatures Fahrenheit/Centigrade		●		●	●

- 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.
- 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 manufacturers 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 after an impact has distorted or misaligned them.
- MA129 Distinguishes Congruence/Similarity Geometric Figures
 - The technician can distinguish whether or not the angle between related parts (e.g. body 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 specification.
- MA132 Distinguishes Estimate/Exact Value
 - The technician can distinguish the need to use an exact value versus an estimated value, depending upon the structural damage and integrity of the system.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
 - The technician estimates the anticipated performance outcome of a normally operating system as well as the expected outcome of everyday occurrences such as the result of a body 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. suspension system, chassis, or body component alignment) and verify its conformance to the manufacturer's specified angle as well as the angle of the spray pattern or spray equipment.
- 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 dimension requiring geometric alignment principles.

- MA170 Identifies Lines Vertical/Horizontal
 - The technician must be very skilled in determining if the lines of an automobile are vertical or horizontal as specified in the original design specifications.
- 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.
- 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, and 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 tolerances and specifications.
- MA182 Measures Direct Temperature
 - The technician can use appropriate temperature measurement tools to determine the existing temperature of ambient air and that of paints and inhibitors.
- MA183 Measures Direct Time
 - The technician needs to measure time since it is very critical to the proper mixing, application, and drying of certain finishes and substances.
- MA184 Measures Direct Volume
 - The technician can use various measurements to determine the volume of finishing and filler compounds to be applied or mixed.
- 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.
- MA186 Measures Indirect
 - The technician can use various forms of indirect measurement to determine if components are in conformance 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.

MA191	Measures	Metric	Temperature
	- The technician can use metric temperature measurement instruments to determine ambient air temperature and that of paints and inhibitors.		
MA192	Measures	Metric	Volume
	- The technician can determine the volume of a 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.		
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.		
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 body component, chassis, or steering and suspension system.		
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.		
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.		

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
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	●	●		●	●
SC116	Describes/Explains Chemical Reactions Catalysis	●	●		●	●
SC121	Describes/Explains Chemical Reactions Inhibitors	●	●		●	●
SC127	Describes/Explains Pigmentation/Color					●
SC130	Describes/Explains Color Spectrum					●
SC177	Describes/Explains Electricity		●	●		
SC178	Describes/Explains Batteries		●	●		
SC180	Describes/Explains Conductors		●	●		
SC182	Describes/Explains Current AC-DC			●		
SC184	Describes/Explains Electricity Ground	●	●	●		

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
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		●	●		
SC205	Describes/Explains Electricity - Measurement Voltage		●	●		
SC212	Describes/Explains Electrochemical Reactions Activity of Metals	●	●	●		●
SC213	Describes/Explains Electrochemical Reactions Oxidation/Reduction	●	●	●		●

**RELATED SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
SC217	Describes/Explains Electromagnetism Magnetic Fields/Force	●	●	●		
SC219	Describes/Explains Electromagnetism Magnets					●
SC236	Describes/Explains Energy Momentum	●	●	●		
SC248	Describes/Explains Force	●				
SC249	Describes/Explains Energy Force, Balanced/Unbalanced		●	●		
SC253	Describes/Explains Force Inertia	●	●			
SC255	Describes/Explains Force Pressure	●	●	●		●
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	●	●		●	●
SC321	Describes/Explains Light Angle of Incidence/Reflection					●
SC329	Describes/Explains Light Opaque					●
SC335	Describes/Explains Light Translucent/Transparent					●
SC336	Describes/Explains Light Ultraviolet					●

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
SC338	Describes/Explains Matter Density/Specific Gravity		●	●		
SC341	Describes/Explains Matter Phases/States	●	●		●	●
SC355	Describes/Explains Motion Velocity					●
SC395	Describes/Explains Solutions Solvent	●	●		●	●
SC399	Describes/Explains Sound Carriers/Insulators	●	●	●		
SC404	Describes/Explains Sound Frequency-Hertz	●	●	●		
SC406	Describes/Explains Sound Noise/Acoustics	●	●	●		
SC411	Describes/Explains Sound Resonance	●	●	●		
SC443	Describes/Explains Weather/Climate Relative Humidity	●	●		●	●
SC447	Describes/Explains Work Levers	●				
SC448	Describes/Explains Work Pulleys	●				
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	●	●	●	●	●

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
SC497	Measures Volume Liquids/Solids	●	●	●	●	●
SC499	Uses Computers Information Processing/Estimating	●	●	●	●	●
SC502	Measures Parameters Electrical	●	●	●		
SC503	Describes/Explains Fluid System Hydraulics	●	●	●		
SC504	Describes/Explains Fluid System Pneumatics	●	●	●	●	●
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					
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			●		

**RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS
EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS**

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST		I. Structural Analysis & Damage Repair	II. Non-Structural Analysis & Damage Repair	III. Mechanical & Electrical Components	IV. Plastic Repair	V. Painting & Refinishing
Ras Code	Description					
SC518	Describes/Explains Electricity Mechanical Transducers	●	●	●		
SC520	Measures Flow Rate					●
SC521	Describes/Explains Flow Rate					●
SC522	Applies/Uses Ratio Proportion Mixtures	●	●		●	●
SC527	Describes/Explains Acids/Bases/pH					●
SC528	Describes/Explains Adhesives/Sealants	●	●		●	●
SC529	Identifies Physical Properties Glass/Polymers	●	●	●	●	●
SC530	Describes/Explains Chemical Reactions Activators		●		●	●
SC531	Describes/Explains Viscosity	●	●	●	●	●
SC532	Describes/Explains Light Source					●

**Science Related Academic Skills
for the
NATEF Collision Repair and Refinish 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 autobody 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 an automobile body 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: identify the problem, gather information, develop hypothesis, take action, 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 the automobile.
- SC116 Describes/Explains Chemical Reactions Catalysts
- The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.
- SC121 Describes/Explains Chemical Reactions Inhibitors
- The technician can explain the purpose of adding additives to an autobody repair compound.
- SC127 Describes/Explains Pigmentation/Color
- The technician can describe and explain the role that pigmentation plays in determining the specific shade of an automobile body or interior color.
- SC130 Describes/Explains Color Spectrum
- The technician demonstrates an understanding of the total spectrum of color by explaining the roles different colors play in a mixture.

- 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 vehicle.
- 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 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, 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.
- 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.
- 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 on an automotive finish.
- 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.
- SC219 Describes/Explains Electromagnetism Magnets
- The technician can explain how attaching magnets to an automobile body can cause paint to be evenly distributed through the principles of magnetism.
- SC236 Describes/Explains Energy Momentum
- The technician can explain how energy is dissipated through the body based on the momentum of the vehicle at the time of the impact.
- SC248 Describes/Explains Force
- The technician can explain the principles of force as it applies to the realignment of a component.
- 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 vehicle assemblies.
- SC253 Describes/Explains Force Inertia
- The technician can explain how the rate of a force in motion can impact on an automobile body in a variety of ways.
- SC255 Describes/Explains Force Pressure
- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.
- 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 automotive 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 maintaining stable temperatures or in preventing the transfer of heat to an unwanted area.
- SC282 Describes/Explains Heat Temperature
- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.
- SC321 Describes/Explains Light Angle of Incidence/Reflection
- The technician can explain how the angle or amount of light can impact on the appearance of a given finish in terms of texture and quality of finish.
- SC329 Describes/Explains Light Opaque
-The technician can explain color and shades of color based on how light hits it.
- SC335 Describes/Explains Light Translucent/Transparent
- The technician can explain the difference between the principles of translucent light (diffuses) as contrasted to transparent light (passes through).
- SC336 Describes/Explains Light Ultraviolet
- The technician can explain how ultraviolet rays can cause a finish or substance to deteriorate.
- 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.
- SC355 Describes/Explains Motion Velocity
- The technician can explain how the velocity of an object in motion impacts on another object.
- SC395 Describes/Explains Solutions Solvent
- The technician understands the use and safety requirements of all solvents used in an autobody environment.
- SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the body and engine can be carried to other parts of the body or engine through metal and other materials.
- 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 vehicle.
- 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 effect on paint and substance applications.
- 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 tension gauges such as a torque wrench to measure the force or tension required to tighten connections according to the manufacturer's specifications.
- SC493 Measures Mass/Weight
- The technician uses a scale to measure component weight in order to mix an adhesive or to determine the strength and integrity of a component or part.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic paint 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 for proper cure and application times.
- SC496 Measures Time
- The technician uses direct and indirect methods to measure application times, mixing guidelines for certain products, and labor time guides for selected tasks.
- 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, continuity, and/or power.

- 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 automobile body and structure.
- SC504 Describes/Explains Fluid System Pneumatics
 - The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.
- 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 as well as how fillers and finishes adhere to metal.
- 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 spray patterns, volume, etc.
- 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 the finish or a plastic component.
- 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 component operational parameters depending on inputs from sensors such as for the air bag or AC system.
- 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 explain how a generator operates as well as its ability to provide a continuous flow of electricity to a 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 modify the system's operating characteristics.
- SC520 Measures Flow Rate
 - The technician can use precision gauges or instruments to measure the flow rate of air in a painting application.
- SC521 Describes/Explains Flow Rate
 - The technician can demonstrate an understanding of how variances in flow rate can effect the spray patters, thickness of coat, etc., in the finishing process.
- SC522 Applies/Uses Ratio Proportion Mixtures
 - The technician can correctly use proportions and ratios in mixing fillers, finishes, and other substances.
- SC527 Describes/Explains Acids/Bases/pH
 - The technician can explain the role that acids and bases have in altering compounds used on or in the automobile.
- SC528 Describes/Explains Adhesives/Sealants
 - The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.
- SC529 Identifies Physical Properties Glass/Polymers
 - The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.
- SC530 Describes/Explains Chemical Reactions Activators
 - The technician can describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.
- SC531 Describes/Explains Viscosity
 - The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.
- SC532 Describes/Explains Light Source
 - The technician can accurately locate and explain the properties of a given source of light.

- 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 for clarity and adequacy 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.

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- 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.
- 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.
- LA271 Uses Dictionary
 -The technician refers to the dictionary to define terms or to check spelling.
- 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 automotive and autobody 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 (STRUCTURAL ANALYSIS AND DAMAGE REPAIR)

- 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.
- MA014 Calculates/Evaluates Measurement Precision
- The technician uses a variety of techniques to determine if selected measurements are precise and in congruence with 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.
- 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.
- 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.
- 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 manufacturers 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 after an impact has distorted or misaligned them.
- MA129 Distinguishes Congruence/Similarity Geometric Figures
- The technician can distinguish whether or not the angle between related parts (e.g. body 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 specification.
- MA132 Distinguishes Estimate/Exact Value
- The technician can distinguish the need to use an exact value versus an estimated value, depending upon the structural damage and integrity of the system.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
- The technician estimates the anticipated performance outcome of a normally operating system as well as the expected outcome of everyday occurrences such as the result of a body 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. chassis or body 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 dimension requiring geometric alignment principles.
- MA170 Identifies Lines Vertical/Horizontal
- The technician must be very skilled in determining if the lines of an automobile are vertical or horizontal as specified in the original design specifications.
- 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.
- 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.

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- 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.
- MA186 Measures Indirect
- The technician can use various forms of indirect measurement to determine if components are in conformance 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 vessel when the specifications are in liters.
- 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 body component or chassis.
- 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.
- 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.

SCIENCE SKILLS (STRUCTURAL ANALYSIS AND DAMAGE REPAIR)

- 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 autobody 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 an automobile body 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: *i* identify the problem; *j* gather information; *k* develop hypothesis; *l* take action; ... 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 the automobile.
- SC116 Describes/Explains Chemical Reactions Catalysts
 - The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.
- SC121 Describes/Explains Chemical Reactions Inhibitors
 - The technician can explain the purpose of adding additives to an autobody repair compound.
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 - 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.
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 - The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.

SC213	Describes/Explains - The technician can explain the effect of oxidation on electrical connections as well as on an automotive finish.	Electrochemical Reactions	Oxidation/Reduction
SC217	Describes/Explains - The technician can explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.	Electromagnetism	Magnetic Fields/Force
SC236	Describes/Explains - The technician can explain how energy is dissipated through the body based on the momentum of the vehicle at the time of the impact.	Energy	Momentum
SC248	Describes/Explains - The technician can explain the principles of force as it applies to the realignment of a component.	Force	
SC253	Describes/Explains - The technician can explain how the rate of a force in motion can impact on an automobile body.	Force	Inertia
SC255	Describes/Explains - The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.	Force	Pressure
SC274	Describes/Explains - The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various automotive systems.	Heat	Conduction/Convection
SC277	Describes/Explains - 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.	Heat	Expansion/Contraction
SC278	Describes/Explains - 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.	Heat	Fusion/Vaporization
SC280	Describes/Explains - The technician can explain the role of insulation in maintaining stable temperatures or in preventing the transfer of heat to an unwanted area.	Heat	Insulation
SC282	Describes/Explains - The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.	Heat	Temperature
SC341	Describes/Explains - The technician can explain in detail the three states of matter.	Matter	Phases/States
SC395	Describes/Explains - The technician understands the use and safety requirements of all solvents used in an autobody environment.	Solutions	Solvent
SC399	Describes/Explains - The technician can demonstrate an understanding of how sound generated in one place in the body and engine can be carried to other parts of the body or engine through metal and other materials.	Sound	Carriers/Insulators
SC404	Describes/Explains - The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating system.	Sound	Frequency-Hertz

- SC406 Describes/Explains Sound Noise/Acoustics
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- The technician can demonstrate an understanding of what happens when an object resonates.
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- The technician uses precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power.
- 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 automobile body and structure.

- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.
- 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 as well as how fillers and finishes adhere to metal.
- 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.
- 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 component operational parameters depending on inputs from sensors such as for the air bag or AC system.
- 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.
- 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 in mixing fillers, finishes, and other substances.
- SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.
- SC529 Identifies Physical Properties Glass/Polymers
- The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.
- SC531 Describes/Explains Viscosity
- The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

- 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 for clarity and adequacy 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.
- 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.
- LA271 Uses Dictionary
 -The technician refers to the dictionary to define terms or to check spelling.
- 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 automotive and autobody 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 (NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR)

- 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.
- 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.
- 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.
- 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 manufacturers for specifying the correct measurement or tolerance.

- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
 - The technician estimates the anticipated performance outcome of a normally operating system as well as the expected outcome of everyday occurrences such as the result of a body 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. body 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 dimension requiring geometric alignment principles.
- MA170 Identifies Lines Vertical/Horizontal
 - The technician must be very skilled in determining if the lines of an automobile are vertical or horizontal as specified in the original design specifications.
- 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.
- 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.
- 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.
- MA183 Measures Direct Time
 - The technician measures time which is very critical to proper mixing, application, and drying of certain adhesives, fillers, etc.
- 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.

- MA186 Measures Indirect
- The technician can use various forms of indirect measurement to determine if components are in conformance 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 vessel when the specifications are in liters.
- 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 body component.
- 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.
- 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.

SCIENCE SKILLS (NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR)

- 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 autobody 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 an automobile body 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: *i* identify the problem; *j* gather information; *k* develop hypothesis; *l* take action; ... 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 the automobile.
- SC116 Describes/Explains Chemical Reactions Catalysts
- The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.
- SC121 Describes/Explains Chemical Reactions Inhibitors
- The technician can explain the purpose of adding additives to an autobody repair compound.
- 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 vehicle.
- 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.
- 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.

SC187	Describes/Explains - The technician can demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.	Electricity	Short Circuit
SC199	Describes/Explains - The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit.	Electricity - Measurement	Ammeter/Voltmeter
SC201	Describes/Explains - 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.	Electricity - Measurement	Fuse
SC204	Describes/Explains - The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.	Electricity - Measurement	Resistance
SC205	Describes/Explains - The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.	Electricity - Measurement	Voltage
SC212	Describes/Explains - The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.	Electrochemical Reactions	Activity of Metals
SC213	Describes/Explains - The technician can explain the effect of oxidation on electrical connections as well as on an automotive finish.	Electrochemical Reactions	Oxidation/Reduction
SC217	Describes/Explains - The technician can explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.	Electromagnetism	Magnetic Fields/Force
SC236	Describes/Explains - The technician can explain how energy is dissipated through the body based on the momentum of the vehicle at the time of the impact.	Energy	Momentum
SC249	Describes/Explains - The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating vehicle assemblies.	Energy	Force, Balanced/Unbalanced
SC253	Describes/Explains - The technician can explain how the rate of a force in motion can impact on an automobile body.	Force	Inertia
SC255	Describes/Explains - The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.	Force	Pressure
SC274	Describes/Explains - The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various automotive systems.	Heat	Conduction/Convection
SC277	Describes/Explains - 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.	Heat	Expansion/Contraction

- 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 maintaining stable temperatures or in preventing the transfer of heat to an unwanted area.
- SC282 Describes/Explains Heat Temperature
- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.
- 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.
- SC395 Describes/Explains Solutions Solvent
- The technician understands the use and safety requirements of all solvents used in an autobody environment.
- SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the body and engine can be carried to other parts of the body or engine through metal and other materials.
- 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 vehicle.
- 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 effect on paint and substance applications.
- 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 tension gauges such as a torque wrench to measure the force or tension required to tighten connections according to the manufacturer's specifications.

- SC493 Measures Mass/Weight
- The technician uses a scale to measure component weight in order to mix an adhesive or to determine the strength and integrity of a component or part.
- 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 for proper cure and application times.
- SC496 Measures Time
- The technician uses direct and indirect methods to measure application times, mixing guidelines for certain products, and labor time guides for selected tasks.
- 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, continuity, and/or power.
- 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 automobile body and structure.
- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.
- 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 as well as how fillers and finishes adhere to metal.
- 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.
- 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 component operational parameters depending on inputs from sensors such as for the air bag or AC system.
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- 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.
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- 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 in mixing fillers, finishes, and other substances.
- SC528 Describes/Explains Adhesives/Sealants
 - The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.
- SC529 Identifies Physical Properties Glass/Polymers
 - The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.
- SC530 Describes/Explains Chemical Reactions Activators
 - The technician can describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.
- SC531 Describes/Explains Viscosity
 - The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

III. MECHANICAL AND ELECTRICAL COMPONENTS UNDUPLICATED LIST

LANGUAGE ARTS/COMMUNICATIONS SKILLS

- 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 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 automobile.
- 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.
- 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 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.
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 -The technician refers to the dictionary to define terms or to check spelling.
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 - 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 automotive and autobody 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 (MECHANICAL AND ELECTRICAL COMPONENTS)

- 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.
- MA014 Calculates/Evaluates Measurement Precision
- The technician uses a variety of techniques to determine if selected measurements are precise and in congruence with 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
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- MA047 Computes Division Whole Numbers
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- 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 manufacturers 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 after an impact has distorted or misaligned them.
- MA129 Distinguishes Congruence/Similarity Geometric Figures
- The technician can distinguish whether or not the angle between related parts (e.g. body 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 specification.
- MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
- The technician estimates the anticipated performance outcome of a normally operating system as well as the expected outcome of everyday occurrences such as the result of a body parameter being out of conformance with the manufacturer's specifications.
- MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle (e.g. suspension system or body 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 dimension requiring geometric alignment principles.
- MA170 Identifies Lines Vertical/Horizontal
- The technician must be very skilled in determining if the lines of an automobile are vertical or horizontal as specified in the original design specifications.
- 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.
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- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.
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- 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 - The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.	Direct	Distance
MA184	Measures - The technician can use various measurements to determine the volume of finishing and filler compounds to be applied or mixed.	Direct	Volume
MA186	Measures - The technician can use various forms of indirect measurement to determine if components are in conformance with manufacturer's specifications.	Indirect	
MA190	Measures - The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.	Metric	Distance
MA229	Solves Problems - The technician can identify the specific cause of the described problem by generating conclusions based on known symptoms related to the problem.	Generates Conclusions	Deductive Reasoning
MA239	Understands - The technician understands that if the described problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.	Conditionals	
MA242	Understands - The technician can use and conform to standards defined by each manufacturer for the system being analyzed.	Definitions	Standards
MA244	Understands - The technician can visually perceive the geometric relationships of systems and sub-systems requiring alignment or verification.	Geometric Figures	Visual Perception
MA245	Understands - 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 body component or steering and suspension system.	Line/Angle	Relationships
MA271	Determines - The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.	Proper Operation	
MA273	Computes - When comparing the observed measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.	Tolerances/Ranges	Mentally
MA274	Computes - The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.	Proper Operations	Mentally

SCIENCE SKILLS (MECHANICAL AND ELECTRICAL COMPONENTS)

- 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 autobody 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 an automobile body 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: identify the problem, gather information, develop hypothesis, take action, 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.
- 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 vehicle.
- 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 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, 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.		
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.		
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 on an automotive finish.		
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.		
SC236	Describes/Explains	Energy	Momentum
	- The technician can explain how energy is dissipated through the body based on the momentum of the vehicle at the time of the impact.		
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 vehicle assemblies.		
SC255	Describes/Explains	Force	Pressure
	- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.		
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 automobile systems.		
SC338	Describes/Explains	Matter	Density/Specific Gravity
	- The technician can explain the need for a specific gravity test of battery electrolyte to determine charge.		

- SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the body and engine can be carried to other parts of the body or engine through metal and other materials.
- 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 vehicle.
- SC411 Describes/Explains Sound Resonance
- The technician can demonstrate an understanding of what happens when an object resonates.
- 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 tension gauges such as a torque wrench to measure the force or tension 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 methods to measure system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer for proper cure and application times.
- 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 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, continuity, and/or power.
- 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 automobile body and structure.

- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.
- SC507 Describes/Explains Motion Lubrication
- The technician can discuss the role of lubrication in relation to the concept of friction.
- 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.
- 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 the finish or a plastic component.
- 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 component operational parameters depending on inputs from sensors such as for the air bag or AC system.
- 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 automobile 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.
- SC529 Identifies Physical Properties Glass/Polymers
- The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.
- SC531 Describes/Explains Viscosity
- The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

- 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 for clarity and adequacy 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.

MATH SKILLS (PLASTIC REPAIR)

- | | | | |
|-------|--|------------------|-------------------------------------|
| 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. | | |
| 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. | | |
| 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. | | |
| 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 manufacturers for specifying the correct measurement or tolerance. | | |
| MA153 | Formulates/Verifies | Angles | |
| | - The technician can visually formulate an angle (e.g. body 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. | | |

- 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.
- 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, and thousandths) when conducting precision measurements.
- 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 ambient air and that of paints and inhibitors.
- MA183 Measures Direct Time
 - The technician needs to measure time which is very critical to proper mixing, application, and drying of certain finishes and substances.
- MA186 Measures Indirect
 - The technician can use various forms of indirect measurement to determine if components are in conformance 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 vessel when the specifications are in liters.
- MA242 Understands Definitions Standards
 - The technician can use and conform to standards defined by each manufacturer for the system being analyzed.
- 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 body component.
- 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.
- 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.

SCIENCE SKILLS (PLASTIC REPAIR)

- 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 autobody 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 an automobile body 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: identify the problem, gather information, develop hypothesis, take action, 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 the automobile.
- SC116 Describes/Explains Chemical Reactions Catalysts
- The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.
- SC121 Describes/Explains Chemical Reactions Inhibitors
- The technician can explain the purpose of adding additives to an autobody repair compound.
- 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 automotive 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 maintaining stable temperatures or in preventing the transfer of heat to an unwanted area.

SC282	Describes/Explains	Heat	Temperature
	- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.		
SC341	Describes/Explains	Matter	Phases/States
	- The technician can explain in detail the three states of matter.		
SC395	Describes/Explains	Solutions	Solvent
	- The technician understands the use and safety requirements of all solvents used in an autobody environment.		
SC443	Describes/Explains	Weather/Climate	Relative Humidity
	- The technician can demonstrate an understanding of and discuss relative humidity in terms of effect on paint and substance applications.		
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 tension gauges such as a torque wrench to measure the force or tension required to tighten connections according 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 for proper cure and application times.		
SC496	Measures	Time	
	- The technician uses direct and indirect methods to measure application times, mixing guidelines for certain products, and labor time guides for selected tasks.		
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.		
SC504	Describes/Explains	Fluid System	Pneumatics
	- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.		
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.		
SC513	Describes/Explains	Force	Torque
	- The technician can demonstrate an understanding of how torque relates to force and angular acceleration.		
SC522	Applies/Uses	Ratio	Proportion Mixtures
	- The technician can correctly use proportions and ratios in mixing fillers, finishes, and other substances.		

- SC528 Describes/Explains Adhesives/Sealants
 - The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.
- SC529 Identifies Physical Properties Glass/Polymers
 - The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.
- SC530 Describes/Explains Chemical Reactions Activators
 - The technician can describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.
- SC531 Describes/Explains Viscosity
 - The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

- 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 for clarity and adequacy 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.
- 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.
- LA271 Uses Dictionary
 -The technician refers to the dictionary to define terms or to check spelling.
- 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 automotive and autobody 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 (PAINTING & REFINISHING)

MA026	Computes - The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.	Addition	Decimals
MA028	Computes - The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.	Addition	Mentally
MA034	Computes - The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.	Addition	Whole Numbers
MA039	Computes - The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.	Division	Decimals
MA047	Computes - The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.	Division	Whole Numbers
MA065	Computes - The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.	Multiplication	Decimals
MA067	Computes - The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.	Multiplication	Mentally
MA073	Computes - The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.	Subtraction	Whole Numbers
MA084	Computes - The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.	Subtraction	Decimals
MA086	Computes - The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.	Subtraction	Mentally
MA092	Computes - The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.	Subtraction	Whole Numbers
MA126	Converts - 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 manufacturers for specifying the correct measurement or tolerance.	Units	English/Metric -- Feet/Meters, e.g.
MA153	Formulates/Verifies - The technician can visually formulate and verify the angle of the spray pattern or spray equipment.	Angles	
MA161	Identifies - 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.	English Measures	Length/Volume/Weight

- 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.
- 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, and thousandths) when conducting precision measurements.
- 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 ambient air and that of paints and inhibitors.
- MA183 Measures Direct Time
 - The technician needs to measure time which is very critical to proper mixing, application, and drying of certain finishes and substances.
- MA186 Measures Indirect
 - The technician can use various forms of indirect measurement to determine if components are in conformance 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.
- MA191 Measures Metric Temperature
 - The technician can use metric temperature measurement instruments to determine ambient air temperature and that of paints and inhibitors.
- MA192 Measures Metric Volume
 - The technician can determine the volume of a 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.
- MA242 Understands Definitions Standards
 - The technician can use and conform to standards defined by each manufacturer for the 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.
- 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.

SCIENCE SKILLS (PAINTING & REFINISHING)

- 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 autobody 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 an automobile body 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: identify the problem, gather information, develop hypothesis, take action, 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 the automobile.
- SC116 Describes/Explains Chemical Reactions Catalysts
- The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.
- SC121 Describes/Explains Chemical Reactions Inhibitors
- The technician can explain the purpose of adding additives to an autobody repair compound.
- SC127 Describes/Explains Pigmentation/Color
- The technician can describe and explain the role that pigmentation plays in determining the specific shade of an automobile body or interior color.
- SC130 Describes/Explains Color Spectrum
- The technician demonstrates an understanding of the total spectrum of color by explaining the roles different colors play in a mixture.
- 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 on an automotive finish.

SC219	Describes/Explains	Electromagnetism	Magnets
	- The technician can explain how attaching magnets to an automobile body can cause paint to be evenly distributed through the principles of magnetism.		
SC255	Describes/Explains	Force	Pressure
	- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.		
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 automotive 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.		
SC282	Describes/Explains	Heat	Temperature
	- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.		
SC321	Describes/Explains	Light	Angle of Incidence/Reflection
	- The technician can explain how the angle or amount of light can impact on the appearance of a given finish in terms of texture and quality of finish.		
SC329	Describes/Explains	Light	Opaque
	-The technician can explain color and shades of color based on how light hits it.		
SC335	Describes/Explains	Light	Translucent/Transparent
	- The technician can explain the difference between the principles of translucent light (diffuses) as contrasted to transparent light (passes through).		
SC336	Describes/Explains	Light	Ultraviolet
	- The technician can explain how ultraviolet rays can cause a finish or substance to deteriorate.		
SC341	Describes/Explains	Matter	Phases/States
	- The technician can explain in detail the three states of matter.		
SC355	Describes/Explains	Motion	Velocity
	- The technician can explain how the velocity of an object in motion impacts on another object.		
SC395	Describes/Explains	Solutions	Solvent
	- The technician understands the use and safety requirements of all solvents used in an autobody environment.		
SC443	Describes/Explains	Weather/Climate	Relative Humidity
	- The technician can demonstrate an understanding of and discuss relative humidity in terms of effect on paint and substance applications.		
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.
- SC493 Measures Mass/Weight
- The technician uses a scale to measure component weight in order to mix an adhesive or to determine the strength and integrity of a component or part.
- SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic paint 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 for proper cure and application times.
- SC496 Measures Time
- The technician uses direct and indirect methods to measure application times, mixing guidelines for certain products, and labor time guides for selected tasks.
- 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.
- SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.
- 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 as well as how fillers and finishes adhere to metal.
- SC510 Describes/Explains Fluid System Dynamics
- The technician can explain the dynamic control properties of a hydraulic system in terms of its impact on spray patterns, volume, etc.
- 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 the finish or a plastic component.
- SC520 Measures Flow Rate
- The technician can use precision gauges or instruments to measure the flow rate of air in a painting application.
- SC521 Describes/Explains Flow Rate
- The technician can demonstrate an understanding of how variances in flow rate can effect the spray patterns, thickness of coat, etc., in the finishing process.

- SC522 Applies/Uses Ratio Proportion Mixtures
 - The technician can correctly use proportions and ratios in mixing fillers, finishes, and other substances.
- SC527 Describes/Explains Acids/Bases/pH
 - The technician can explain the role that acids and bases have in altering compounds used on or in the automobile.
- SC528 Describes/Explains Adhesives/Sealants
 - The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.
- SC529 Identifies Physical Properties Glass/Polymers
 - The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.
- SC530 Describes/Explains Chemical Reactions Activators
 - The technician can describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.
- SC531 Describes/Explains Viscosity
 - The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.
- SC532 Describes/Explains Light Source
 - The technician can accurately locate and explain the properties of a given source of light.

TASK LIST AND ASSUMPTIONS

The NATEF task list was reviewed and updated in March 2009. A national committee was assembled in Herndon, Virginia to review the standards used in the collision repair and refinish certification program. The committee consisted of individuals representing collision repair and refinish shop owners and technicians, collision repair and refinish instructors, collision repair and refinish equipment and parts suppliers, and the Inter-Industry Conference on Auto Collision Repair (I-CAR).

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

All the tasks are assigned a "High Priority" designation. **Certified programs must include at least 95% of the HP-I tasks and 90% of the HP-G tasks in the curriculum.** Please refer to the Task List Information in the Policies section for additional information on the requirements for instruction on tasks.

1. It is assumed that:
 - * in all areas, appropriate safety, theory, and support instruction will be required for performing each task;
 - * the instruction has included identification and use of 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 publications.

2. It is assumed that:
 - * all components are steel unless otherwise specified;
 - * current manufacturers recommended repair procedures are available for each vehicle used in instruction;
 - * all diagnostic and repair tasks described in this document are to be accomplished in accordance with manufacturer's recommended procedures/specifications as published;
 - * where manufacturer's recommended guidelines are not available, published industry guidelines are used;
 - * all tools and equipment comply with applicable federal, state and local regulations.

3. It is assumed that:
 - * individual training programs being evaluated for certification should have written and detailed performance standards for each task covered and taught in the curriculum;
 - * learning progress of students will be monitored and evaluated against these performance standards;

- * a system is in place that informs all students of their individual progress through all phases of the training program.

4. It is assumed that:

- * individual courses of study will differ across collision repair and refinish 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 as required in Hazard Communication Title 29, Code of Federal Regulation Part 1910.1200, '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.

DEFINITIONS – TECHNICAL TERMS

ACTIVE SUSPENSION SYSTEM – A continuously controlled self-adjusting suspension system.

ADJUST – To bring components or equipment to specified operational settings.

AIR PURIFYING RESPIRATOR – Uses a filter, cartridge, or canister to remove specific air contaminants by passing ambient air through the purifying element.

ALIGN (REALIGN) – To adjust components to a line or predetermined relative position.

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

ANCHOR – To hold in place.

APPLY – To put on, attach, or affix chemicals, components or parts by spraying, brushing, spreading or using hardware.

BLEED – To remove air from a closed system.

BUFF – To remove fine scratches, usually from a painted surface, using a fine abrasive such as compounds and polishes.

CHECK – (SEE VERIFY).

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

COLD SHRINK – To restore contour, shape, and dimensions to stretched sheet metal areas utilizing appropriate hammer and dolly techniques.

CONDITION – To prepare for future action.

DENIB – To remove dust/dirt particles in a painted surface.

DETERMINE – To establish the type and extent of damage to a component or the procedure to be used to affect the necessary repair.

DEVELOP (PLAN) – To identify, arrange or organize the steps or procedural components into a logical sequence of actions.

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

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

FEATHEREDGE – To taper and smooth the edges of a damaged area using abrasives.

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

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

GRIND – To remove material using a motor-driven abrasive wheel, disk or pad.

HEAT SHRINK – To restore contour, shape and dimensions to stretched sheet metal areas by applying heat and utilizing appropriate hammer and dolly techniques.

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

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

INSTALL (REINSTALL) – To secure or attach a component in its proper position in a system.

LEAK TEST – To check for and/or locate leaks in a component or system.

LOCATE – To find by using tools, measuring instruments, equipment or the senses.

MASK – To protect a component or area from incidental damage from the application of refinishing materials.

MEASURE – To compare existing dimensions to specified dimensions by the use of calibrated instruments and gauges.

MIX – To combine or blend into one mass or mixture.

PERFORM – To accomplish a procedure in accordance with established methods and standards.

PROTECT – To take actions to prevent damage to areas of the vehicles adjacent to the repair area.

REDUCE – To lower the viscosity of a refinishing material.

REFINISH – To apply cleaners, paint, and other finishing materials to the repair areas.

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

REPAIR (RESTORE) – To return damaged areas to acceptable size, dimensions, shape, performance characteristics and condition.

REPLACE – To exchange a damaged component with a new or used component.

RESTORE – (SEE REPAIR)

ROUGH SAND – To remove body filler, primer/substrate, or finish materials using coarse abrasives.

SAND – To abrade or level the surface.

SCUFF – To abrade or degloss a surface for the purpose of adhesion.

SELECT – To choose the correct part, tool, equipment or setting during an assembly, adjustment or procedure.

SETUP – To select and assemble components, assemblies or parts in order or combination to produce desired results.

STORE – To organize and put away parts, hardware, and components for future retrieval and use.

STRAIGHTEN – To remove bends, creases, and other damage while returning a component to acceptable size, shape, and condition.

STRUCTURAL COMPONENTS – Any part of a vehicle's structure that bears loads, provides strength, and when removed or altered would compromise the integrity of the vehicle.

TINT – To adjust the color or hiding ability of refinishing materials.

VERIFY (CHECK) – To confirm a condition, adjustment or setting.

WASH – To clean by spraying, dipping, rinsing, rubbing or scrubbing.

WELD – To join metal or plastic pieces together by using a thermal process, often adding filler material to the joint.

NATEF TASK LIST

STRUCTURAL ANALYSIS AND DAMAGE REPAIR

For every task in Structural Analysis and Damage Repair, the following safety requirement must be strictly enforced:

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

I. STRUCTURAL ANALYSIS AND DAMAGE REPAIR

A. Frame Inspection and Repair

1. Measure and diagnose structural damage using a tram gauge. HP-I
2. Attach vehicle to anchoring devices. HP-I
3. Analyze, straighten and align mash (collapse) damage. HP-G
4. Analyze, straighten and align sag damage. HP-G
5. Analyze, straighten and align sidesway damage. HP-G
6. Analyze, straighten and align twist damage. HP-G
7. Analyze, straighten and align diamond frame damage. HP-G
8. Remove and replace damaged structural components. HP-G
9. Restore corrosion protection to repaired or replaced frame areas. HP-I
10. Analyze and identify misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering, and wheel alignment problems. HP-G
11. Align or replace misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering, and wheel alignment problems. HP-G
12. Identify heat limitations for structural components. HP-I

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| 13. | Demonstrate an understanding of structural foam applications. | HP-G |
| 14. | Measure and diagnose structural damage using a three-dimensional measuring system (mechanical, electronic, laser), etc. | HP-G |
| 15. | Measure and diagnose structural damage to vehicles using a dedicated (fixture) measuring system. | HP-G |
| 16. | Determine the extent of the direct and indirect damage and the direction of impact; document the methods and sequence of repair. | HP-I |
| 17. | Analyze and identify crush/collapse zones. | HP-I |
| 18. | Restore mounting and anchoring locations. | HP-G |

I. STRUCTURAL ANALYSIS AND DAMAGE REPAIR

B. Unibody and Unitized Structure Inspection, Measurement, and Repair

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| 1. | Analyze and identify misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering, and chassis alignment problems. | HP-G |
| 2. | Realign or replace misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering and chassis alignment problems. | HP-G |
| 3. | Measure and diagnose unibody damage using tram gauge. | HP-I |
| 4. | Determine and inspect the locations of all suspension, steering, and powertrain component attaching points on the vehicle. | HP-G |
| 5. | Measure and diagnose unibody vehicles using a dedicated (fixture) measuring system. | HP-G |
| 6. | Diagnose and measure unibody vehicles using a three-dimensional measuring system (mechanical, electronic, and laser, etc.). | HP-G |
| 7. | Determine the extent of the direct and indirect damage and the direction of impact; plan and document the methods and sequence of repair. | HP-I |
| 8. | Attach anchoring devices to vehicle; remove or reposition components as necessary. | HP-I |
| 9. | Straighten and align cowl assembly. | HP-G |
| 10. | Straighten and align roof rails/headers and roof panels. | HP-G |

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| 11. | Straighten and align hinge and lock pillars. | HP-G |
| 12. | Straighten and align vehicle openings, floor pans, and rocker panels. | HP-G |
| 13. | Straighten and align quarter panels, wheelhouse assemblies, and rear body sections (including rails and suspension/powertrain mounting points). | HP-G |
| 14. | Straighten and align front-end sections (aprons, strut towers, upper and lower rails, steering, and suspension/power train mounting points, etc.). | HP-G |
| 15. | Identify substrate and repair or replacement recommendations. | HP-I |
| 16. | Identify proper cold stress relief methods. | HP-I |
| 17. | Repair damage using power tools and hand tools to restore proper contours and dimensions. | HP-I |
| 18. | Remove and replace damaged sections of steel body structures. | HP-G |
| 19. | Restore corrosion protection to repaired or replaced structural areas. | HP-I |
| 20. | Determine the extent of damage to aluminum structural components; repair, weld, or replace. | HP-G |
| 21. | Analyze and identify crush/collapse zones. | HP-I |
| 22. | Restore mounting and anchoring locations. | HP-G |

I. STRUCTURAL ANALYSIS AND DAMAGE REPAIR

C. Fixed Glass

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| 1. | Remove and reinstall or replace fixed glass (heated and non-heated) using recommended materials and techniques. | HP-G |
| 2. | Remove and reinstall or replace modular glass using recommended materials. | HP-G |
| 3. | Check for water leaks, dust leaks, and wind noise. | HP-G |

I. STRUCTURAL ANALYSIS AND DAMAGE REPAIR

D. Metal Welding and Cutting

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| 1. | Identify weldable and non-weldable substrates used in vehicle construction. | HP-I |
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2. Weld and cut high-strength steel and other steels. HP-I
3. Weld and cut aluminum. HP-G
4. Determine the correct GMAW (MIG) welder type, electrode/wire type, diameter, and gas to be used in a specific welding situation. HP-I
5. Set up and adjust the GMAW (MIG) welder to "tune" for proper electrode stickout, voltage, polarity, flow rate, and wire-feed speed required for the substrate being welded. HP-I
6. Store, handle, and install high-pressure gas cylinders. HP-I
7. Determine work clamp (ground) location and attach. HP-I
8. Use the proper angle of the gun to the joint and direction of gun travel for the type of weld being made in the flat, horizontal, vertical, and overhead positions. HP-I
9. Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations. HP-I
10. Protect computers and other electronic control modules during welding procedures. HP-I
11. Clean and prepare the metal to be welded, assure good metal fit-up, apply weld-through primer if necessary, clamp or tack as required. HP-I
12. Determine the joint type (butt weld with backing, lap, etc.) for weld being made. HP-I
13. Determine the type of weld (continuous, stitch weld, plug, etc.) for each specific welding operation. HP-I
14. Perform the following welds: continuous, plug, butt weld with and without backing, and fillet etc. HP-I
15. Perform visual and destructive tests on each weld type. HP-I
16. Identify the causes of various welding defects; make necessary adjustments. HP-I
17. Identify cause of contact tip burn-back and failure of wire to feed; make necessary adjustments. HP-I
18. Identify cutting process for different substrates and locations; perform cutting operation. HP-I

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| 19. | Identify different methods of attaching structural components (squeeze type resistance spot welding (STRSW), riveting, structural adhesive, silicon bronze, etc.). | HP-G |
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NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR (BODY COMPONENTS)

For every task in Non-Structural Analysis and Damage Repair (Body Components), the following safety requirement must be strictly enforced:

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

II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR (BODY COMPONENTS)

A. Preparation

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| 1. | Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan. | HP-I |
| 2. | Inspect, remove, store, and replace exterior trim and moldings. | HP-I |
| 3. | Inspect, remove, store, and replace interior trim and components. | HP-I |
| 4. | Inspect, remove, store, and replace body panels and components that may interfere with or be damaged during repair. | HP-I |
| 5. | Inspect, remove, store, and replace vehicle mechanical and electrical components that may interfere with or be damaged during repair. | HP-G |
| 6. | Protect panels, glass, interior parts, and other vehicles adjacent to the repair area. | HP-I |
| 7. | Soap and water wash entire vehicle for inspection. | HP-I |
| 8. | Prepare damaged area using water-based and solvent-based cleaners. | HP-I |
| 9. | Remove corrosion protection, undercoatings, sealers, and other protective coatings as necessary to perform repairs. | HP-I |
| 10. | Inspect, remove, and reinstall repairable plastics and other components for off-vehicle repair. | HP-I |

II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR (BODY COMPONENTS)

B. Outer Body Panel Repairs, Replacements, and Adjustments

1. Determine the extent of direct (primary) and indirect (secondary) damage and direction of impact; develop and document a repair plan. HP-I
2. Inspect, remove and replace bolted, bonded, and welded steel panel or panel assemblies. HP-G
3. Determine the extent of damage to aluminum body panels; repair or replace. HP-G
4. Inspect, remove, replace, and align hood, hood hinges, and hood latch. HP-I
5. Inspect, remove, replace, and align deck lid, lid hinges, and lid latch. HP-I
6. Inspect, remove, replace, and align doors, latches, hinges, and related hardware. HP-I
7. Inspect, remove, replace and align tailgates, hatches, liftgates and sliding doors. HP-G
8. Inspect, remove, replace, and align bumper bars, covers, reinforcement, guards, isolators, and mounting hardware. HP-I
9. Inspect, remove, replace and align fenders, and related panels. HP-I
10. Straighten contours of damaged panels to a suitable condition for body filling or metal finishing using power tools, hand tools, and weld-on pulling attachments. HP-I
11. Weld damaged or torn steel body panels; repair broken welds. HP-G
12. Restore corrosion protection. HP-I
13. Replace door skins. HP-G
14. Restore sound deadeners and foam materials. HP-G
15. Perform panel bonding. HP-G
16. Diagnose and repair water leaks, dust leaks, and wind noise. HP-G
17. Identify one-time use fasteners. HP-G

II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR (BODY COMPONENTS)

C. Metal Finishing and Body Filling

1. Remove paint from the damaged area of a body panel. HP-I
2. Locate and repair surface irregularities on a damaged body panel. HP-I
3. Demonstrate hammer and dolly techniques. HP-I
4. Heat shrink stretched panel areas to proper contour. HP-I
5. Cold shrink stretched panel areas to proper contour. HP-I
6. Mix and apply body filler. HP-I
7. Rough sand body filler to contour; finish sand. HP-I
8. Determine the proper metal finishing techniques for aluminum. HP-G
9. Determine proper application of body filler to aluminum. HP-G

II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR (BODY COMPONENTS)

D. Moveable Glass and Hardware

1. Inspect, adjust, repair or replace window regulators, run channels, glass, power mechanisms, and related controls. HP-I
2. Inspect, adjust, repair, remove, reinstall or replace weather-stripping. HP-G
3. Inspect, repair or replace, and adjust removable power operated roof panel and hinges, latches, guides, handles, retainer, and controls of sunroofs. HP-G
4. Inspect, remove, reinstall, and align convertible top and related mechanisms. HP-G

II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR (BODY COMPONENTS)

E. Metal Welding and Cutting

1. Identify weldable and non-weldable substrates used in vehicle construction. HP-I
2. Weld and cut high-strength steel and other steels. HP-I
3. Weld and cut aluminum. HP-G

4. Determine the correct GMAW (MIG) welder type, electrode/wire type, diameter, and gas to be used in a specific welding situation. HP-I
5. Set up and adjust the GMAW (MIG) welder to "tune" for proper electrode stickout, voltage, polarity, flow rate, and wire-feed speed required for the substrate being welded. HP-I
6. Store, handle, and install high-pressure gas cylinders. HP-I
7. Determine work clamp (ground) location and attach. HP-I
8. Use the proper angle of the gun to the joint and direction of gun travel for the type of weld being made in the flat, horizontal, vertical, and overhead positions. HP-I
9. Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations. HP-I
10. Protect computers and other electronic control modules during welding procedures. HP-I
11. Clean and prepare the metal to be welded, assure good metal fit-up, apply weld-through primer if necessary, clamp or tack as required. HP-I
12. Determine the joint type (butt weld with backing, lap, etc.) for weld being made. HP-I
13. Determine the type of weld (continuous, stitch weld, plug, etc.) for each specific welding operation. HP-I
14. Perform the following welds: continuous, plug, butt weld with and without backing, fillet, etc. HP-I
15. Perform visual and destructive tests on each weld type. HP-I
16. Identify the causes of various welding defects; make necessary adjustments. HP-I
17. Identify cause of contact tip burn-back and failure of wire to feed; make necessary adjustments. HP-I
18. Identify cutting process for different substrates and locations; perform cutting operation. HP-I
19. Identify different methods of attaching non-structural components (squeeze type resistant spot welds (STRSW), riveting, non-structural adhesive, silicon bronze, etc.). HP-G

F. Plastics and Adhesives

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| 1. | Identify the types of plastics; determine repairability. | HP-I |
| 2. | Clean and prepare the surface of plastic parts; identify the types of plastic repair procedures. | HP-I |
| 3. | Repair rigid, semi-rigid, or flexible plastic panels. | HP-I |
| 4. | Remove or repair damaged areas from rigid exterior composite panels. | HP-G |
| 5. | Replace bonded rigid exterior composite body panels; straighten or align panel supports. | HP-G |

MECHANICAL AND ELECTRICAL COMPONENTS

For every task in Mechanical and Electrical Components, the following safety requirement must be strictly enforced:

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

III. MECHANICAL AND ELECTRICAL COMPONENTS

A. Suspension and Steering

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| 1. | Identify one-time use fasteners. | HP-I |
| 2. | Clean, inspect, and prepare reusable fasteners. | HP-I |
| 3. | Remove, replace, inspect or adjust power steering pump, pulleys, belts, hoses, fittings and pump mounts. | HP-G |
| 4. | Remove and replace power steering gear (non-rack and pinion type). | HP-G |
| 5. | Inspect, remove, and replace power rack and pinion steering gear and related components. | HP-G |
| 6. | Inspect and replace parallelogram steering linkage components. | HP-G |

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| 7. | Inspect, remove and replace upper and lower control arms and related components. | HP-G |
| 8. | Inspect, remove and replace steering knuckle/spindle/hub assemblies (including bearings, races, seals, etc.). | HP-G |
| 9. | Inspect, remove and replace front suspension system coil springs and spring insulators (silencers). | HP-G |
| 10. | Inspect, remove, replace, and adjust suspension system torsion bars, and inspect mounts. | HP-G |
| 11. | Inspect, remove and replace stabilizer bar bushings, brackets, and links. | HP-G |
| 12. | Inspect, remove and replace MacPherson strut cartridge or assembly, upper bearing, and mount. | HP-G |
| 13. | Inspect, remove, and replace rear suspension system transverse links, control arms, stabilizer bars, bushings, and mounts. | HP-G |
| 14. | Inspect, remove, and replace suspension system leaf spring(s and related components). | HP-G |
| 15. | Inspect axle assembly for damage and misalignment. | HP-G |
| 16. | Inspect, remove and replace shock absorbers. | HP-G |
| 17. | Diagnose, inspect, adjust, repair or replace active suspension systems and associated lines and fittings. | HP-G |
| 18. | Measure vehicle ride height; determine needed repairs. | HP-I |
| 19. | Inspect, remove, replace, and align front and rear frame (cradles/sub). | HP-G |
| 20. | Diagnose and inspect steering wheel, steering column, and components. | HP-G |
| 21. | Verify proper operation of steering system. | HP-G |
| 22. | Diagnose front and rear suspension system noises and body sway problems; determine needed repairs. | HP-G |
| 23. | Diagnose vehicle wandering, pulling, hard steering, bump steer, memory steering, torque steering, and steering return problems; determine needed repairs. | HP-G |

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| 24. | Demonstrate an understanding of suspension and steering alignments (caster, camber, toe, SAI) etc.. | HP-G |
| 25. | Diagnose tire wear patterns; determine needed repairs. | HP-I |
| 26. | Inspect tires; identify direction of rotation and location; check tire size, tire pressure monitoring system (TPM) and adjust air pressure. | HP-I |
| 27. | Diagnose wheel/tire vibration, shimmy, tire pull (lead), wheel hop problems; determine needed repairs. | HP-G |
| 28. | Measure wheel, tire, axle, and hub runout; determine needed repairs. | HP-I |
| 29. | Reinstall wheels and torque lug nuts. | HP-I |

III. MECHANICAL AND ELECTRICAL COMPONENTS

B. Electrical

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| 1. | Check for available voltage, voltage drop and current in electrical wiring circuits and components with a DMM (digital multimeter). | HP-I |
| 2. | Repair electrical circuits, wiring, and connectors. | HP-I |
| 3. | Inspect, test, and replace fusible links, circuit breakers, and fuses. | HP-I |
| 4. | Perform battery state-of-charge test and slow/fast battery charge.. | HP-I |
| 5. | Inspect, clean, repair or replace battery, battery cables, connectors and clamps. | HP-I |
| 6. | Dispose of batteries and battery acid according to local, state, and federal requirements. | HP-G |
| 7. | Identify programmable electrical/electronic components and check for malfunction indicator lamp (MIL); record data for reprogramming before disconnecting battery. | HP-I |
| 8. | Inspect alignment, adjust, remove and replace alternator (generator), drive belts, pulleys, and fans. | HP-I |
| 9. | Check operation and aim headlamp assemblies and fog/driving lamps; determine needed repairs. | HP-I |
| 10. | Inspect, test, and repair or replace switches, relays, bulbs, sockets, connectors, and wires of interior and exterior light circuits. | HP-I |

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| 11. | Remove and replace horn(s); check operation. | HP-I |
| 12. | Check operation of wiper/washer systems; determine needed repairs. | HP-I |
| 13. | Check operation of power side and tailgate window; determine needed repairs. | HP-I |
| 14. | Inspect, remove and replace power seat, motors, linkages, cables, etc. | HP-G |
| 15. | Inspect, remove and replace components of electric door and hatch/trunk lock. | HP-G |
| 16. | Inspect, remove and replace components of keyless lock/unlock devices and alarm systems. | HP-G |
| 17. | Inspect, remove and replace components of electrical sunroof and convertible/retractable hard top. | HP-G |
| 18. | Check operation of electrically heated mirrors, windshields, back lights, panels, etc.; determine needed repairs. | HP-I |
| 19. | Demonstrate the proper self-grounding procedures for handling electronic components. | HP-I |
| 20. | Check for module communication errors using a scan tool. | HP-G |
| 21. | Use wiring diagrams and diagnostic flow charts during diagnosis of electrical circuit problems. | HP-G |
| 22. | Demonstrate safe disarming techniques of high voltage systems on hybrid vehicles. | HP-G |
| 23. | Identify potential safety and environmental concerns associated with hybrid vehicle systems. | HP-G |

III. MECHANICAL AND ELECTRICAL COMPONENTS

C. Brakes

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| 1. | Inspect brake lines, hoses, and fittings for leaks, dents, kinks, rust, cracks or wear; tighten fittings and supports; replace brake lines (double flare and ISO types), hoses, fittings, seals, and supports. | HP-I |
| 2. | Identify, handle, store, and install appropriate brake fluids; dispose of in accordance with federal, state, and local regulations. | HP-G |
| 3. | Bleed (manual, pressure, vacuum or surge) hydraulic brake system. | HP-I |

4. Pressure test brake hydraulic system; determine needed repair. HP-G
5. Adjust brake shoes; remove and reinstall brake drums or drum/hub assemblies and wheel bearings. HP-I
6. Remove, clean and inspect caliper assembly and mountings for wear and damage; reinstall. HP-I
7. Check parking brake system operation. HP-I
8. Identify the proper procedures for handling brake dust. HP-G
9. Check for bent or damaged brake system components. HP-G
10. Demonstrate an understanding of various types of advanced braking systems (ABS, hydraulic, electronic, traction control). HP-G

III. MECHANICAL AND ELECTRICAL COMPONENTS

D. Heating and Air Conditioning

1. Identify and comply with environmental concerns relating to refrigerants and coolants. HP-G
2. Maintain and verify correct operation of certified refrigerant recovery and recharging equipment. HP-G
3. Locate and identify A/C system service ports. HP-I
4. Identify, recover, label and store refrigerant from A/C system. HP-G
5. Recycle refrigerant in accordance with EPA regulations. HP-G
6. Evacuate and recharge A/C system; check for leaks. HP-I
7. Identify oil type and maintain correct amount in A/C system. HP-G
8. Inspect, adjust, and replace A/C compressor drive belts; check pulley alignment. HP-G
9. Remove and replace A/C compressor; inspect, repair or replace A/C compressor mount. HP-G
10. Inspect, repair or replace A/C system mufflers, hoses, lines, fittings, orifice tube, expansion valve, and seals. HP-G
11. Inspect, test, and replace A/C system condenser and mounts. HP-G

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| 12. | Inspect and replace receiver/drier or accumulator/drier. | HP-G |
| 13. | Inspect and repair A/C component wiring. | HP-G |
| 14. | Demonstrate an understanding of safe handling procedures associated with high voltage A/C compressors and wiring. | HP-G |

III. MECHANICAL AND ELECTRICAL COMPONENTS

E. Cooling Systems

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| 1. | Check engine cooling and heater system hoses and belts; determine needed repairs. | HP-I |
| 2. | Inspect, test, remove, and replace radiator, pressure cap, coolant recovery system, and water pump. | HP-G |
| 3. | Recover, refill, and bleed system with proper coolant and check level of protection; leak test system and dispose of materials in accordance with EPA specifications. | HP-I |
| 4. | Remove, inspect and replace fan (both electrical and mechanical), fan sensors, fan pulley, fan clutch, and fan shroud; check operation. | HP-G |
| 5. | Inspect, remove, and replace auxiliary oil/fluid coolers; check oil levels. | HP-G |
| 6. | Demonstrate an understanding of hybrid cooling systems. | HP-G |

III. MECHANICAL AND ELECTRICAL COMPONENTS

F. Drive Train

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| 1. | Remove, replace, and adjust shift or clutch linkage as required. | HP-G |
| 2. | Remove, replace, and adjust cables or linkages for throttle valve (TV), kickdown, and accelerator pedal. | HP-G |
| 3. | Remove and replace electronic sensors, wires, and connectors. | HP-G |
| 4. | Remove and replace powertrain assembly; inspect, replace, and align powertrain mounts. | HP-G |
| 5. | Remove and replace drive axle assembly. | HP-G |
| 6. | Inspect, remove and replace half shafts and axle constant velocity (CV) joints. | HP-G |

7. Inspect, remove and replace drive shafts and universal joints. HP-G

III. MECHANICAL AND ELECTRICAL COMPONENTS

G. Fuel, Intake and Exhaust Systems

1. Inspect, remove and replace exhaust pipes, mufflers, converters, resonators, tail pipes, and heat shields. HP-G
2. Inspect, remove and replace fuel tank, tank filter, cap, filler hose, pump/sending unit and inertia switch; inspect and replace fuel lines and hoses. HP-G
3. Inspect, remove and replace engine components of air intake systems. HP-G
4. Inspect, remove and replace canister, filter, vent, and purge lines of fuel vapor (EVAP) control systems. HP-G

III. MECHANICAL AND ELECTRICAL COMPONENTS

H. Restraint Systems

1. Identify vehicle manufacturer's SRS recommended procedures before inspecting or replacing components. HP-I
2. Inspect, remove, and replace seatbelt and shoulder harness assembly and components. HP-G
3. Inspect restraint system mounting areas for damage; repair as needed. HP-G
4. Verify proper operation of seatbelt. HP-I
5. Deactivate and reactivate Supplemental Restraint System (SRS). HP-G
6. Inspect, remove and replace Supplemental Restraint Systems (SRS) sensors and wiring; ensure sensor orientation. HP-G
7. Verify that Supplemental Restraint System (SRS) is operational. HP-I
8. Inspect, remove, replace and dispose of deployed and non-deployed airbag(s) and pretensioners. HP-G
9. Use Diagnostic Trouble Codes (DTC) to diagnose and repair the Supplemental Restraint System (SRS). HP-G
10. Demonstrate an understanding of advanced restraint systems. HP-G

PAINTING AND REFINISHING

For every task in Painting and Refinishing, the following safety requirement must be strictly enforced:

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

IV. PAINTING AND REFINISHING

A. Safety Precautions

1. Identify and take necessary precautions with hazardous operations and materials according to federal, state, and local regulations. HP-I
2. Identify safety and personal health hazards according to OSHA guidelines and the “Right to Know Law”. HP-I
3. Inspect spray environment and equipment to ensure compliance with federal, state and local regulations, and for safety and cleanliness hazards. HP-I
4. Select and use a NIOSH approved air purifying respirator. Inspect condition and ensure fit and operation. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation. HP-I
5. Select and use a NIOSH approved supplied air (Fresh Air Make-up) respirator system. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation HP-I
6. Select and use the proper personal safety equipment for surface preparation, spray gun and related equipment operation, paint mixing, matching and application, paint defects, and detailing (gloves, suits, hoods, eye and ear protection, etc.). HP-I

B. Surface Preparation

1. Inspect, remove, store, and replace exterior trim and components necessary for proper surface preparation. HP-I
2. Soap and water wash entire vehicle; use appropriate cleaner to remove contaminants. HP-I

3. Inspect and identify substrate, type of finish, surface condition, and film thickness; develop and document a plan for refinishing using a total product system. HP-I
4. Strip paint to bare substrate (paint removal). HP-I
5. Dry or wet sand areas to be refinished. HP-I
6. Featheredge damaged areas to be refinished. HP-I
7. Apply suitable metal treatment or primer in accordance with total product systems. HP-I
8. Mask and protect other areas that will not be refinished. HP-I
9. Mix primer, primer-surfacer or primer-sealer. HP-I
10. Apply primer onto surface of repaired area. HP-I
11. Apply two-component finishing filler to minor surface imperfections. HP-I
12. Dry or wet sand area to which primer-surfacer has been applied. HP-I
13. Dry sand area to which two-component finishing filler has been applied. HP-I
14. Remove dust from area to be refinished, including cracks or moldings of adjacent areas. HP-I
15. Clean area to be refinished using a final cleaning solution. HP-I
16. Remove, with a tack rag, any dust or lint particles from the area to be refinished. HP-I
17. Apply suitable sealer to the area being refinished. HP-I
18. Scuff sand to remove nibs or imperfections from a sealer. HP-I
19. Apply stone chip resistant coating. HP-G
20. Restore corrosion-resistant coatings, caulking, and seam sealers to repaired areas. HP-G
21. Prepare adjacent panels for blending. HP-I
22. Identify the types of rigid, semi-rigid or flexible plastic parts to be refinished; determine the materials, preparation, and refinishing procedures. HP-I

23. Identify aluminum parts to be refinished; determine the materials, preparation, and refinishing procedures. HP-G

C. Spray Gun and Related Equipment Operation

1. Inspect, clean, and determine condition of spray guns and related equipment (air hoses, regulators, air lines, air source, and spray environment). HP-I
2. Check and adjust spray gun operation for HVLP (high volume, low pressure) or compliant spray guns. HP-I
3. Set-up (fluid needle, nozzle, and cap), test, and adjust spray gun using fluid, air, and pattern control valves. HP-I
4. Demonstrate an understanding of the operation of pressure spray equipment. HP-G

IV. PAINTING AND REFINISHING

D. Paint Mixing, Matching, and Applying

1. Identify type and color code by manufacturer's vehicle information label. HP-I
2. Shake, stir, reduce, catalyze/activate, and strain refinish materials. HP-I
3. Apply finish using appropriate spray techniques (gun arc, gun angle, gun distance, gun speed, and spray pattern overlap) for the finish being applied. HP-I
4. Apply selected product on test and let-down panel; check for color match. HP-I
5. Apply single stage topcoat. HP-I
6. Apply basecoat/clearcoat for panel blending or panel refinishing. HP-I
7. Apply basecoat/clearcoat for overall refinishing. HP-G
8. Remove nibs or imperfections from basecoat. HP-I
9. Refinish rigid or semi-rigid, and plastic parts. HP-G
10. Refinish flexible plastic parts. HP-I
11. Apply multi-stage coats for panel blending or overall refinishing. HP-G
12. Identify and mix paint using a formula. HP-I
13. Identify poor hiding colors; determine necessary action. HP-G

14. Tint color using formula to achieve a blendable match. HP-I

15. Identify alternative color formula to achieve a blendable match. HP-I

IV. PAINTING AND REFINISHING

E. Paint Defects - Causes and Cures

1. Identify blistering (raising of the paint surface, air entrapment); determine the cause(s) and correct the condition. HP-G

2. Identify blushing (milky or hazy formation); determine the cause(s) and correct the condition. HP-G

3. Identify a dry spray appearance in the paint surface; determine the cause(s) and correct the condition. HP-G

4. Identify the presence of fish-eyes (crater-like openings) in the finish; determine the cause(s) and correct the condition. HP-I

5. Identify lifting; determine the cause(s) and correct the condition. HP-G

6. Identify clouding (mottling and streaking in metallic finishes); determine the cause(s) and correct the condition. HP-I

7. Identify orange peel; determine the cause(s) and correct the condition. HP-I

8. Identify overspray; determine the cause(s) and correct the condition. HP-I

9. Identify solvent popping in freshly painted surface; determine the cause(s) and correct the condition. HP-G

10. Identify sags and runs in paint surface; determine the cause(s) and correct the condition. HP-I

11. Identify sanding marks or sandscratch swelling; determine the cause(s) and correct the condition. HP-G

12. Identify contour mapping/edge mapping while finish is drying; determine the cause(s) and correct the condition. HP-G

13. Identify color difference (off-shade); determine the cause(s) and correct the condition. HP-G

14. Identify tape tracking; determine the cause(s) and correct the condition. HP-G

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| 15. | Identify low gloss condition; determine the cause(s) and correct the condition. | HP-G |
| 16. | Identify poor adhesion; determine the cause(s) and correct the condition. | HP-G |
| 17. | Identify paint cracking (shrinking, splitting, crowsfeet or line-checking, micro-checking, etc.); determine the cause(s) and correct the condition. | HP-G |
| 18. | Identify corrosion; determine the cause(s) and correct the condition. | HP-G |
| 19. | Identify dirt or dust in the paint surface; determine the cause(s) and correct the condition. | HP-I |
| 20. | Identify water spotting; determine the cause(s) and correct the condition. | HP-G |
| 21. | Identify finish damage caused by bird droppings, tree sap, and other natural causes; correct the condition. | HP-G |
| 22. | Identify finish damage caused by airborne contaminants (acids, soot, rail dust, and other industrial-related causes); correct the condition. | HP-G |
| 23. | Identify die-back conditions (dulling of the paint film showing haziness); determine the cause(s) and correct the condition. | HP-G |
| 24. | Identify chalking (oxidation); determine the cause(s) and correct the condition. | HP-G |
| 25. | Identify bleed-through (staining); determine the cause(s) and correct the condition. | HP-G |
| 26. | Identify pin-holing; determine the cause(s) and correct the condition. | HP-G |
| 27. | Identify buffing-related imperfections (swirl marks, wheel burns); correct the condition. | HP-I |
| 28. | Identify pigment flotation (color change through film build); determine the cause(s) and correct the condition. | HP-G |

IV. PAINTING AND REFINISHING

F. Final Detail

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| 1. | Apply decals, transfers, tapes, woodgrains, pinstripes (painted and taped), etc. | HP-G |
| 2. | Buff and polish finish to remove defects as required. | HP-I |
| 3. | Clean interior, exterior, and glass. | HP-I |

4. Clean body openings (door jambs and edges, etc.). HP-I
5. Remove overspray. HP-I
6. Perform pre-delivery detail and inspection. HP-I

Task List Priority Item Totals (by area)

I. Structural Analysis and Damage Repair

HP-I = 31 (includes 17 welding) 95% = 29 tasks

HP-G = 31 (includes 2 welding) 90% = 28 tasks

II. Non-Structural Analysis and Damage Repair (Body Components)

HP-I = 45 (includes 17 welding) 95% = 43 tasks

HP-G = 19 (includes 2 welding) 90% = 17 tasks

III. Mechanical and Electrical Components

HP-I = 33 95% = 31 tasks

HP-G = 70 90% = 63 tasks

IV. Painting and Refinishing

HP-I = 52 95% = 49 tasks

HP-G = 30 90% = 27 tasks