

NATIONAL AUTOMOTIVE TECHNICIANS EDUCATION FOUNDATION

English SCIENCE

MATHEMATICS

Integrated Academic Skills



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A correlation of

**Automotive Technician
Applied Academic Skills**

with selected national
standards for English,
mathematics and
science.

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Preface

Knowledge that cannot be applied has little utility in today's complex, technologically driven world. For centuries, societies have recognized that a keen understanding of mathematics, science and communications skills were essential to cultural preservation and progress. But historically, such disciplines were taught and perpetuated in isolation of their application in the real world, a world where people must work and make a living.

However, with the advent of technology at an ever accelerating pace, there has been a rethinking regarding the most effective methodologies for teaching math, science and communication skills. Teaching those disciplines in the context of where and how people live and work is not only gaining in acceptance, but it is deemed critical to survival in a technology-imbued environment.

For example, an automotive technician's job description consists of far more than the performance of manipulative tasks required to service today's complex motor vehicles. Today's successful technician must possess an array of workplace skills and a unique blend of academic and technical skills.

This document includes a description of those essential workplace skills an automotive technician needs to function successfully in an automotive service facility. It also includes a listing of the integrated math, science and communications skills required of today's automotive technician to effectively analyze, diagnose, service and/or repair today's technically sophisticated automobiles.

The intent of this document is twofold: (1) To serve as a resource to educational institutions and automotive technology teachers in planning, preparing, delivering and assessing instructional content for preparing automotive technicians of the future; and (2) To demonstrate the extent to which today's automotive technician is dependent upon and must be competent in the application of appropriate math, science and communication skills in the day-to-day performance of his/her job.

Acknowledgements

A publication of this nature is virtually without precedent due to the dearth of formal research and professional writings that have addressed the correlation of applied academic skills and national standards for English, mathematics and science. But with the cumulative experiences of some pioneering applied academic teachers and automotive technology instructors, this publication serves as a starting point to further develop and refine the concept and enhance the integrity of the applied academic movement as an effective method for the teaching of communications, math and science understandings and skills. Additionally, this publication adds credibility to the importance of workplace and academic skills in the successful performance of automotive technicians in the work place.

A special thank you is extended to Glencoe McGraw-Hill Companies for convening the participants and hosting the workshop that addressed the topic at hand.

NATEF is also indebted to the following individuals who contributed much time, thought and counsel regarding much of the content included this document: Jason Feldner, Applied Math Teacher, Mid-East Ohio Career & Technology Centers, Buffalo Campus, Senecaville, Ohio; Janet Capps, Gordon Cooper Technology Center, Shawnee, Okla.; Al Blethen, Automotive Technology Instructor, Shelton State Community College, Tuscaloosa, Ala.; Ted Grekowicz, Michigan Technical Academy (retired), Romulus, Mich.; Charlotte Sanders, Francis Tuttle Vo-Tech Center, Oklahoma City, Okla.; Barbara Carstens, Butler Career & Technology Development Schools, Hamilton, Ohio; Erick Dodge, OCM BOCES, Syracuse, N.Y.; Leo Van Delft, Automotive Technology Instructor, Tulsa Technology Center, Tulsa, Okla.; Patsy Kline, Applied Communications Consultant, Jones, Okla.; Laura Marcy, Applied Communications Teacher, C-TEC, Newark, Ohio; Patrick Hart, Automotive Technology Instructor, New York Automotive and Diesel Institute, Jamaica, N.Y.; Robert Porter, Center for Technical Studies of Montgomery County, Plymouth Meeting, Penn.; and Sue Elsasser, Technical Writer, Sparland, Illinois.

Introduction

Much of the information reflected in this document builds upon two earlier NATEF publications, the 2005 ASE Certification for Automobile Training Programs manual and the 1996 Applied Academic and Workplace Skills for Automobile Technicians manual.

Utilizing the services of a national jury of experts comprised of veteran automotive technology instructors and secondary education applied English, math and science teachers, each automotive task identified in the above-referenced certification manual was scrutinized for academic implications and imbedded academic content. Stated another way, the jurists identified the essential communications, math, or science skills associated with the successful performance of a given automotive task.

Once the academic content had been determined in terms of learner tasks or skills, they were stated in a format similar to the NATEF automotive tasks and referred to as applied academic skills, codified in their respective academic disciplines. The end result was a list of communications, math and science skills required of an automotive technician to perform successfully in his/her craft/trade.

The applied academic skills were then correlated with comparable national standards for English, mathematics, and science as published by the International Reading Association/National Council of Teachers of English, the National Council of Teachers of Mathematics, and the National Science Teachers Association.

In the applied academics section of this publication, the reader will find a spreadsheet listing the NATEF applied academic skills, the parallel national academic standard/s and the applicable automotive specialty area/s where such knowledge and skills would be applied.

Hopefully, secondary school administrators, curriculum planners, academic and automotive teachers and instructional resource developers will find the information in this document helpful in course of study design for automotive technology and applied academic endeavors.

Workplace Skills

Workplace skills are those traits of a non-technical nature that learners must possess to secure and maintain productive employment as an automotive technician. Workplace skills are often referred as soft skills, or employability skills, and generally relate to the attitudinal, social and behavioral dimensions of a successful worker's profile.

The workplace skills reflected here are the same as appeared in the 1995 edition of NATEF's Applied Academic & Workplace Skills for Automobile Technicians publication. Those skills were reviewed by the individuals listed in the Acknowledgements section of this publication and were deemed as still being appropriate for the purpose intended.

A. DEVELOPING AN EMPLOYMENT PLAN

1. Match interests to employment area.
2. Match aptitudes to employment area.
3. Identify short-term work goals.
4. Match attitudes to job area.
5. Match physical capabilities to a job area.
6. Demonstrate a drug-free status.

B. SEEKING AND APPLYING FOR EMPLOYMENT OPPORTUNITIES

1. Identifying steps in applying for a job.
2. Locate employment opportunities.
3. Identify job opportunities.
4. Identify conditions for employment.
5. Evaluate job opportunities.
6. Prepare a resume.
7. Write job application letter.
8. Complete job application form.
9. Prepare for job interview.
10. Dress for job interview.

C. ACCEPTING EMPLOYMENT

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

D. COMMUNICATING ON THE JOB

1. Communicate orally with others.
2. Ask questions about tasks.
3. Follow written and oral directions.
4. Prepare written communications.
5. Interpret the use of body language.
6. Use telephone etiquette.

E. DETERMINING THE ECONOMICS OF WORK

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

F. MAINTAINING PROFESSIONALISM

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

G. ADAPTING/COPING WITH CHANGE

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

H. SOLVING PROBLEMS AND CRITICAL THINKING

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

I. MAINTAINING A SAFE AND HEALTHY ENVIRONMENT

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

J. DEMONSTRATING WORK ETHICS AND BEHAVIOR

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

K. DEMONSTRATING TECHNOLOGY LITERACY

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

L. MAINTAINING INTERPERSONAL RELATIONSHIP

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

M. DEMONSTRATING TEAMWORK

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

Applied Academic Skills

The following is a listing of applied academic skills for automotive technicians, sequenced in the order of applied communications, mathematics and science.

Each matrix is divided into three columns. The first column reflects a NATEF identified applied academic task with a numerical designation for reference purposes. All numerical designations are preceded by the letters AC, AM or AS for applied communications, applied math, or applied science.

The second column lists the national standard/s for English, mathematics, or science that correlates to the respective NATEF applied academic skill. All of the correlated national standards apply to grades nine through twelve. On occasion, there will be no national standard correlate for a NATEF applied academic skill because if there was a national standard correlate, it was appropriate at less than the ninth grade level.

The third column designates what automotive specialty area/s the applied academic skill is applicable. The automotive specialty areas are coded in the third column as follows:

- AT—Automatic Transmission and Transaxle;
- BR— Brakes;
- EL—Electrical/Electronic Systems;
- EP—Engine Performance;
- ER—Engine Repair;
- HA—Heating & Air Conditioning;
- MD—Manual Drive Train and Axles; and
- SS—Suspension & Steering.

Applied Communication Skills

NATEF Applied Communications/ Language Arts Skills	National Council of Teachers of English and International Reading Association Standards for the English Language Arts	Applicable Auto Specialty Area
AC-1 Reading The technician adapts a reading strategy for all written materials, e.g., customer's notes, service information, and computer/data readouts, to help identify the solution to the problem.	3. Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics). 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.	ER, AT, MD, SS, BR, EL, HA, EP
AC-2 Information – Written The technician can comprehend and apply the available written information needed to diagnose, analyze, and solve problems.	7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.	ER, AT, MD, SS, BR, EL, HA, EP
AC-3 Abbreviations/Acronyms The technician identifies and uses written abbreviations and acronyms in diagnosing and solving problems.	3. Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics). 4. Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.	ER, AT, MD, SS, BR, EL, HA, EP
AC-4 Information – Written The technician evaluates the usefulness of available written information clearly and thoroughly when analyzing a problem.	3. Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics). 4. Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.	ER, AT, MD, SS, BR, EL, HA, EP
AC-5 Information – Written The technician makes logical inferences and recommendations based on information provided on the repair order.	7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.	ER, AT, MD, SS, BR, EL, HA, EP

AC-6	Charts/Tables/Graphs The technician consults charts, tables, and graphs to determine the manufacturer's specifications to identify out-of-tolerance system components.	<ul style="list-style-type: none"> 3. Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics). 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-7	Sequence The technician consults service information to determine the appropriate sequence of procedures required for solving a specific problem.	<ul style="list-style-type: none"> 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-8	Dictionary The technician refers to a dictionary to check spelling and define unfamiliar terms.	<ul style="list-style-type: none"> 6. Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-9	Text Resources The technician uses glossaries, indexes, database menus, and tables of contents to gather the information needed for diagnosis and repair.	<ul style="list-style-type: none"> 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-10	Databases The technician uses databases to obtain service information.	<ul style="list-style-type: none"> 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-11	Operator's Manual The technician comprehends and applies information from accompanying manuals in order to use and maintain automotive tools and equipment.	<ul style="list-style-type: none"> 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-12	Service (Shop) Manual The technician uses service information in both database and print formats to identify potential malfunctions.	<ul style="list-style-type: none"> 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-13	Skimming/Scanning The technician reviews service information to identify problems and applies that information to appropriate repair procedures.	<ul style="list-style-type: none"> 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP

AC-14	Directions/Task The technician follows all written and oral directions that relate to the applicable task or system.	<ol style="list-style-type: none"> Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-15	Listening/Reading/ Speaking/Writing The technician identifies and uses effective strategies for listening, reading, speaking, and writing when dealing with customers, co-workers, and supervisors.	<ol style="list-style-type: none"> Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics). Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-16	Study Habits/Methods The technician uses proven research methods when consulting the manufacturer's service information (e.g., shop manuals, service bulletins, and computer databases).	<ol style="list-style-type: none"> Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics). Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-17	Prior Knowledge The technician uses prior knowledge of similar problems to determine the specific cause(s) of problems.	<ol style="list-style-type: none"> Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics). 	ER, AT, MD, SS, BR, EL, HA, EP
AC-18	Cause/Effect Relationships The technician comprehends and uses cause-and-effect relationships presented in service manual problem-solving trees.	<ol style="list-style-type: none"> Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics). Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-19	Definitions The technician applies industry definitions to solve problems in automotive components and systems.	<ol style="list-style-type: none"> Students read a wide range of print and non-print texts to build an understanding of texts, of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP

AC-20	Summaries	The technician uses appropriate grammar and sentence structure when summarizing problems in reports.	<ol style="list-style-type: none"> 5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. 6. Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-21	Sentences	The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.	<ol style="list-style-type: none"> 5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. 6. Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-22	Writing	The technician adapts a writing strategy that is most appropriate for the intended audience (e.g., customers, supervisor, and fellow employees) when documenting repairs.	<ol style="list-style-type: none"> 5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-23	Repair Orders	The technician writes a repair order containing customer vehicle information, customer complaints, parts and materials used w/prices, services performed, labor hours, and suggested repairs/maintenance.	<ol style="list-style-type: none"> 4. Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes. 5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-24	Purpose	The technician adapts speaking and/or writing styles that are consistent with the purpose of the communication.	<ol style="list-style-type: none"> 4. Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes. 5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-25	Notes	The technician makes notes regarding symptoms, possible causes, and other data that will aid in diagnosing and solving the problem.	<ol style="list-style-type: none"> 5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 12. Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information). 	ER, AT, MD, SS, BR, EL, HA, EP
AC-26	Paragraphs	The technician composes complete paragraphs, with appropriate details, presenting accurate information regarding symptoms, diagnosis, and results when preparing warranty claims and work orders.	<ol style="list-style-type: none"> 5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. 6. Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts. 	ER, AT, MD, SS, BR, EL, HA, EP

AC-27	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.	<ol style="list-style-type: none"> 4. Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes. 5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-28	Speaking The technician employs communication strategies for customers, supervisors, and co-workers that will yield high-quality information for use in problem solving.	<ol style="list-style-type: none"> 4. Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes. 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-29	Information—Oral The technician evaluates the usefulness of oral information provided by customers and co-workers when analyzing a problem.	<ol style="list-style-type: none"> 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 9. Students develop an understanding of and respect for diversity in language use, patterns, and dialects across cultures, ethnic groups, geographic regions, and social roles. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-30	Information—Oral The technician makes logical inferences and recommends solutions to problems based on discussions with customers, co-workers, and supervisors.	<ol style="list-style-type: none"> 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-31	Information—Oral The technician comprehends information gathered during discussions with customers, supervisors, and co-workers regarding problem symptoms and possible solutions.	<ol style="list-style-type: none"> 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 9. Students develop an understanding of and respect for diversity in language use, patterns, and dialects across cultures, ethnic groups, geographic regions, and social roles. 	ER, AT, MD, SS, BR, EL, HA, EP
AC-32	Information—Oral/Written The technician analyzes information based on discussions, notes, observations, personal experiences, and data searches that will assist in solving the problem.	<ol style="list-style-type: none"> 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience. 8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. 9. Students develop an understanding of and respect for diversity in language use, patterns, and dialects across cultures, ethnic groups, geographic regions, and social roles. 	ER, AT, MD, SS, BR, EL, HA, EP

<p>AC-33 Information Supplying The technician clarifies information to customers, associates, parts suppliers, and supervisors.</p>	<p>4. Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.</p> <p>8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.</p> <p>12. Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).</p>	<p>ER, AT, MD, SS, BR, EL, HA, EP</p>
<p>AC-34 Listening The technician adapts a listening strategy that will obtain the information required for solving the problem.</p>	<p>3. Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics).</p> <p>7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.</p>	<p>ER, AT, MD, SS, BR, EL, HA, EP</p>
<p>AC-35 Nonverbal and Verbal Cues The technician uses verbal and nonverbal cues in discussions to help identify, verify, and solve problems.</p>	<p>7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.</p> <p>9. Students develop an understanding of and respect for diversity in language use, patterns, and dialects across cultures, ethnic groups, geographic regions, and social roles.</p>	<p>ER, AT, MD, SS, BR, EL, HA, EP</p>
<p>AC-36 Information Requests The technician requests specific symptom information from the customer and discusses solutions with supervisors and associates.</p>	<p>4. Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.</p>	<p>ER, AT, MD, SS, BR, EL, HA, EP</p>

Applied Mathematics Skills

NATEF Applied Mathematics Skills	National Council of Teachers of Mathematics Standards	Applicable Auto Specialty Area
AM-1 Whole Numbers The technician can add whole numbers to determine measurement conformance with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases. C2: Judge the reasonableness of numerical computations and their results.	ER, AT, MD, SS, BR, EL, HA, EP
AM-2 Decimals The technician can add decimal numbers to determine conformance with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-3 Mentally The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-4 Whole Numbers The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-5 Decimals The technician can subtract decimal numbers to determine conformance with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-6 Mentally The technician can mentally subtract decimal and whole numbers to arrive at a difference for comparison with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-7 Whole Numbers The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP

AM-8	Decimals The technician can divide decimal numbers to determine measurement conformance with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, SS, EL, EP
AM-9	Mentally The technician can mentally divide decimal and whole numbers to determine conformance with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-10	Whole Numbers The technician can multiply whole numbers to determine differences for comparison with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-11	Decimals The technician can multiply decimal numbers to determine conformance with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-12	Mentally The technician can mentally multiply numbers that include decimal numbers to determine conformance with the manufacturer's specifications.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-13	Add/Subtract/Divide/Multiply The technician can estimate the results of basic arithmetic operations and can accurately round numbers up or down.	Algebra (9–12) C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases. C2: Judge the reasonableness of numerical computations and their results.	ER, AT, MD, SS, BR, EL, HA, EP
AM-14	Mentally The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at the solution.	Number & Operations (9–12) B1: Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities. C1: Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases. Algebra (9–12) B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-15	Mean/Median/Mode The technician can calculate the average (mean) of several measurements to determine any variance from the manufacturer's specifications.	Data Analysis & Probability (9–12) B1: For univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics. C4: Understand how basic statistical techniques are used to monitor process characteristics in the workplace.	EL, EP

AM-16	Charts/Tables/Graphs The technician can construct a chart, table, or graph that depicts and compares a range of performance characteristics of various system operational conditions.	Data Analysis & Probability (9–12) B1: For univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics. B4: Recognize how linear transformations of univariate data affect shape, center, and spread. C1: Use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions. C2: Understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference. C4: Understand how basic statistical techniques are used to monitor process characteristics in the workplace. Representation A1: Create and use representations to organize, record, and communicate mathematical ideas. A3: Use representations to model and interpret physical, social, and mathematical phenomena.	ER, EL, EP
AM-17	Charts/Tables/Graphs The technician can interpret charts, tables, and graphs to determine the manufacturer's specifications for a given system.	Algebra (9–12) C3: Draw reasonable conclusions about a situation being modeled. Representation A2: Select, apply, and translate among mathematical representations to solve problems.	ER, AT, MD, SS, BR, EL, HA, EP
AM-18	Standard/Metric—Feet/Meters The technician can measure/test with tools designed for standard or metric measurements and then convert the resulting measurement to the system used by the manufacturer for specifications and tolerances.	Algebra (9–12) B1: Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations. B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases. Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement. B4: Use unit analysis to check measurement computations.	ER, AT, MD, SS, BR, EL, HA, EP
AM-19	Proper Operation The technician can determine the sequence of arithmetic operations needed to arrive at a solution when comparing system measurements with the manufacturer's specifications.	Algebra (9–12) B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-20	Place Value The technician can interpret standard or metric units when conducting precision measurements.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them.	ER, AT, MD, SS, BR, EL, HA, EP

AM-21	Parallel/Perpendicular	The technician can use measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle systems requiring the application of geometric alignment principles.	Geometry (9–12)	ER, SS
		<p>A1: Analyze properties and determine attributes of two- and three-dimensional objects.</p> <p>A2: Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them.</p> <p>A4: Use trigonometric relationships to determine lengths and angle measures.</p> <p>B1: Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations.</p> <p>C1: Understand and represent translations, reflections, rotations, and dilations of objects in the plane by using sketches, coordinates, vectors, function notation, and matrices.</p> <p>D2: Visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections.</p> <p>D5: Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture.</p>		
AM-22	Angles	The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.	Geometry (9–12)	AT, MD, SS, EL, EP
		<p>A1: Analyze properties and determine attributes of two- and three-dimensional objects.</p> <p>A4: Use trigonometric relationships to determine lengths and angle measures.</p> <p>Measurement (9–12)</p> <p>A1: Make decisions about units and scales that are appropriate for problem situations involving measurement.</p> <p>B1: Analyze precision, accuracy, and approximate error in measurement situations.</p>		
AM-23	Angles	The technician can visually formulate an angle, (e.g., in a suspension system or driveline) and verify its conformance to the manufacturer's specified angle.	Geometry (9–12)	ER, MD, SS, EL, HA, EP
		<p>A1: Analyze properties and determine attributes of two- and three-dimensional objects.</p> <p>A2: Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them.</p> <p>D2: Visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections.</p> <p>D5: Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture.</p>		
AM-24	Geometric Figures	The technician can distinguish whether or not the angles between related parts (e.g., suspension components) are within the manufacturer's specifications.	Geometry (9–12)	ER, SS, EP
		<p>A1: Analyze properties and determine attributes of two- and three-dimensional objects.</p> <p>A4: Use trigonometric relationships to determine lengths and angle measures.</p> <p>D5: Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture.</p>		
AM-25	Relationships	The technician verifies that the relationship of parallel lines and angles is in conformance with the manufacturer's specifications.	Geometry (9–12)	ER, MD, SS
		<p>A2: Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them.</p>		

AM-26	Visual Perception The technician can visually perceive the geometric relationships of systems and subsystems requiring alignment.	Geometry (9–12) D2: Visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections.	ER, SS, EP
AM-27	Distance The technician can measure distance using a variety of devices to determine conformance to the manufacturer's specifications and tolerances.	Geometry (9–12) A4: Use trigonometric relationships to determine lengths and angle measures. Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement. B1: Analyze precision, accuracy, and approximate error in measurement situations.	ER, AT, MD, SS, BR, HA, EP
AM-28	Distance The technician can use standard and metric measurement instruments to determine correct sizes and distances.	Algebra (9–12) C2: Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts. Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement. B4: Use unit analysis to check measurement computations.	ER, AT, MD, SS, BR, HA, EP
AM-29	Volume The technician can use various measurement techniques to determine the volume as applicable.	Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement. B2: Understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinders.	AT, MD, SS, EP
AM-30	Volume The technician can determine if the existing volume is within the manufacturer's recommended tolerance.	Algebra (9–12) B1: Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations. B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases. B3: Use symbolic algebra to represent and explain mathematical relationships	AT, MD, SS, EP
AM-31	Length/Volume/Weight The technician can determine the degree of conformance to the manufacturer's specifications for length, volume, weight, and other appropriate measurements in the standard and metric systems.	Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement. B1: Analyze precision, accuracy, and approximate error in measurement situations.	ER, AT, MD, SS, BR, EL, HA, EP
AM-32	Fahrenheit/Centigrade The technician can identify whether a temperature measurement must be made using a measuring device that measures in °C or °F.	Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement.	ER, HA, EP

AM-33	Temperature The technician can use standard and metric temperature measurement instruments to measure system temperature and determine conformance to metric specifications.	Algebra (9–12) C2: Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts. Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement. B4: Use unit analysis to check measurement computations.	ER, AT, HA, EP
AM-34	Time The technician can use different time measurement tools and techniques to determine if the system's timed or sequenced operating parameters are in conformance with the manufacturer's specifications.	Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement.	AT, BR, EL, HA, EP
AM-35	Standards The technician can demonstrate conformance to standards defined by the industry and/or manufacturer for the system being analyzed.	Algebra (9–12) B1: Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations.	ER, AT, MD, SS, BR, EL, HA, EP
AM-36	Ratios/Percents The technician can convert test readings in decimal or fractional form to a ratio or percentage form for comparison with manufacturer's specifications and vice versa.	Number & Operations (9–12) A1: Develop a deeper understanding of very large and very small numbers and of various representations of them. A2: Compare and contrast the properties of numbers and number systems, including the rational and real numbers, and understand complex numbers as solutions to quadratic equations that do not have real solutions. Algebra (9–12) B1: Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations. B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases. B3: Use symbolic algebra to represent and explain mathematical relationships	ER, EL, EP
AM-37	Mentally When comparing the observed measurement with the manufacturer's specifications, the technician can mentally compute whether the observed measurement meets specifications.	Algebra (9–12) B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases.	ER, AT, MD, SS, BR, EL, HA, EP
AM-38	Estimate/Exact Value The technician can distinguish the need to use a specified value versus an estimated value, depending upon the system malfunction.	Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement.	ER, AT, MD, SS, BR, EL, HA, EP
AM-39	Equal/Not Equal The technician can distinguish when a measurement is not equal to the manufacturer's specifications or tolerances.	Algebra (9–12) B1: Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations.	ER, AT, MD, SS, BR, EL, HA, EP

<p>AM-40 Proportion The technician can solve problems that determine the proportion of variables of a solution and determine if that proportion is within the manufacturer's specifications.</p>	<p>Algebra (9–12) B1: Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations. B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases. B3: Use symbolic algebra to represent and explain mathematical relationships</p>	<p>SS, BR, HA</p>
<p>AM-41 Proportion/Congruence The technician can distinguish the congruence of measurements with tolerances specified by the manufacturer.</p>	<p>Geometry (9–12) A2: Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them.</p>	<p>ER, SS</p>
<p>AM-42 Everyday Occurrences The technician compares the performance outcome of a normally operating system with the anticipated outcome of an everyday occurrence, such as system tolerances to the manufacturer's specifications.</p>	<p>Data Analysis & Probability (9–12) C2: Understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference. C4: Understand how basic statistical techniques are used to monitor process characteristics in the workplace.</p>	<p>ER, AT, MD, SS, BR, EL, HA, EP</p>
<p>AM-43 Direct/Inverse Variation The technician can solve problems requiring the use of fractions, decimals, ratios, and percentages.</p>	<p>Algebra (9–12) B1: Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations. B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases. B3: Use symbolic algebra to represent and explain mathematical relationships Representation A2: Select, apply, and translate among mathematical representations to solve problems.</p>	<p>ER, AT, MD, SS, BR, EL, HA, EP</p>
<p>AM-44 Formulas Using formulae, the technician can predict the outcome/s under different variations.</p>	<p>Algebra (9–12) C1: Identify essential quantitative relationships in a situation and determine the class or classes of functions that might model the relationships. C2: Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts. C3: Draw reasonable conclusions about a situation being modeled. Measurement (9–12) B2: Understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinders. Representation A2: Select, apply, and translate among mathematical representations to solve problems.</p>	<p>AT, MD, SS, BR, EL, HA, EP</p>
<p>AM-45 <, >, =, e.g. The technician can interpret symbols to determine conformance with the manufacturer's specifications.</p>	<p>Algebra (9–12) B4: Use a variety of symbolic representations, including recursive and parametric equations, for functions and relations. B5: Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology. C2: Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts. Representation A2: Select, apply, and translate among mathematical representations to solve problems.</p>	<p>ER, AT, MD, SS, BR, EL, HA, EP</p>

AM-46	Equivalent Form The technician can write or rewrite an algebraic equation to solve for any unknown variables.	Algebra (9–12) B1: Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations. B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases. B3: Use symbolic algebra to represent and explain mathematical relationships C2: Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts. Representation A2: Select, apply, and translate among mathematical representations to solve problems.	EL, EP
AM-47	Specified Symbols The technician can use conventional symbols (E for voltage, etc.) to solve problems using formulas such as Ohm's Law, $E = IR$.	Algebra (9–12) B1: Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations. B2: Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases. B3: Use symbolic algebra to represent and explain mathematical relationships C2: Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts. Representation A2: Select, apply, and translate among mathematical representations to solve problems.	AT, MD, SS, BR, EL, HA, EP
AM-48	Algebraic Expressions The technician can use Ohm's Law and Power Law to determine circuit parameters that are out-of-tolerance.	Algebra (9–12) C2: Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts. C3: Draw reasonable conclusions about a situation being modeled. Measurement (9–12) A1: Make decisions about units and scales that are appropriate for problem situations involving measurement. Problem Solving A2: Solve problems that arise in mathematics and in other contexts. Representation A2: Select, apply, and translate among mathematical representations to solve problems.	EL
AM-49	Conditionals The technician understands that if the described problem has certain conditions (symptoms), then there are a limited number of probable solutions.	Reasoning & Proof A4: Select and use various types of reasoning and methods of proof.	ER, AT, MD, SS, BR, EL, HA, EP
AM-50	Deductive Reasoning The technician can identify the specific cause of the problem by generating conclusions based on known symptoms related to the problem.	Reasoning & Proof A1: Recognize reasoning and proof as fundamental aspects of mathematics. A2: Make and investigate mathematical conjectures. A4: Select and use various types of reasoning and methods of proof.	ER, AT, MD, SS, BR, EL, HA, EP

<p>AM-51 Trial and Error The technician is able to solve problems by trying a suggested solution and observing the results.</p>	<p>Problem Solving A2: Solve problems that arise in mathematics and in other contexts. A3: Apply and adapt a variety of appropriate strategies to solve problems. Reasoning & Proof A4: Select and use various types of reasoning and methods of proof.</p>	<p>SS</p>
<p>AM-52 Probability The technician can relate problem symptoms to the probability of the malfunction of a specific part or system.</p>	<p>Data Analysis & Probability (9–12) C1: Use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions. C2: Understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference. C4: Understand how basic statistical techniques are used to monitor process characteristics in the workplace.</p>	<p>ER, AT, MD, SS, BR, EL, HA, EP</p>
<p>AM-53 Word Problems The technician can evaluate symptoms of problems with a customer or associate technician and identify any relevant missing data required to solve the problem.</p>	<p>Communication A2: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others. A3: Analyze and evaluate the mathematical thinking and strategies of others.</p>	<p>BR, EL, HA, EP</p>

Applied Science Skills

NATEF Applied Science Skills	National Science Teachers Association Standards	Applicable Auto Specialty Area
AS-1 Safety The technician follows all safety regulations and applicable procedures while performing the task.	Science in Personal & Social Perspectives (9–12) A1: Develop an understanding of personal and community health.	ER, AT, MD, SS, BR, EL, HA, EP
AS-2 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 automobile technician.	Science in Personal & Social Perspectives (9–12) A1: Develop an understanding of personal and community health. A5: Develop an understanding of natural and human-induced hazards. A6: Develop an understanding of science and technology in local, national, and global challenges.	ER, AT, MD, SS, BR, EL, HA, EP
AS-3 Environmental Issues 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.	Science in Personal & Social Perspectives (9–12) A1: Develop an understanding of personal and community health. A5: Develop an understanding of natural and human-induced hazards. A6: Develop an understanding of science and technology in local, national, and global challenges.	ER, AT, MD, SS, BR, EL, HA, EP
AS-4 Waste Management The technician identifies the waste products resulting from a repair task.	Science in Personal & Social Perspectives (9–12) A1: Develop an understanding of personal and community health. A5: Develop an understanding of natural and human-induced hazards. A6: Develop an understanding of science and technology in local, national, and global challenges.	ER, AT, MD, SS, BR, EL, HA, EP
AS-5 Waste Management The technician handles the disposal of materials such as automotive lubricants in accordance with applicable federal, state, and local rules and regulations.	Science in Personal & Social Perspectives (9–12) A1: Develop an understanding of personal and community health A5: Develop an understanding of natural and human-induced hazards. A6: Develop an understanding of science and technology in local, national, and global challenges.	ER, AT, MD, SS, BR, EL, HA, EP
AS-6 Operational The technician can relate scientific terms to automotive system diagnosis, service, and repair.		ER, AT, MD, SS, BR, EL, HA, EP
AS-7 Maps/Charts/Tables/Graphs The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer’s specifications for system(s) operation(s).		ER, AT, MD, SS, BR, EL, HA, EP

AS-8	Maps/Charts/Tables/Graphs The technician uses the information in service manual charts, tables, or graphs to determine the appropriate repair/replacement procedure and/or part.		ER, AT, MD, SS, BR, EL, HA, EP
AS-9	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.	Science as Inquiry (9–12) A4: Formulate and revise scientific explanations and models using logic and evidence. Science & Technology (9–12) A1: Identify a problem or design an opportunity. A2: Propose designs and choose between alternative solutions.	ER, AT, MD, SS, BR, EL, HA, EP
AS-10	Standard/Metric The technician can convert measurements taken in the standard or metric system to specifications stated in either system.		ER, AT, MD, SS, BR, EL, HA, EP
AS-11	Information Processing The technician can use computer databases to input and retrieve customer information for billing, warranty work, and other record-keeping purposes.		ER, AT, MD, SS, BR, EL, HA, EP
AS-12	Levers The technician can explain how levers can be used to increase an applied force over distance.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR, EL, EP
AS-13	Pulleys The technician can explain how pulleys can be used to increase an applied force over distance.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, EL, HA, EP
AS-14	Distance/Length The technician can use precision measuring devices to determine if wear and adjustments are within the manufacturer's tolerances.		ER, AT, MD, SS, BR, EL, HA, EP
AS-15	Force The technician can use a tension gauge such as a torque wrench to measure the force or tension required to tighten connections to manufacturer's specifications.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR, EL, HA, EP
AS-16	Balance The technician can measure and balance rotating systems.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, SS

AS-17	Pressure The technician can measure pressures in hydraulic or pneumatic systems and compare them to the manufacturer's specifications.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR, EL, HA, EP
AS-18	Time The technician uses direct and indirect methods to measure time and compares the results to the manufacturer's specifications.		AT, BR, EL, HA, EP
AS-19	Fahrenheit/Centigrade The technician measures system temperatures and converts them to °F and °C as required.		ER, AT, SS, EL, HA, EP
AS-20	Liquids/Solids The technician can measure the volume of a liquid in a system and compare it to the manufacturer's specifications.		ER, AT, MD, SS, EL, HA
AS-21	Fractional Distillation The technician can explain the ignition characteristics of fuels resulting from varying levels of fractional distillation (fuels with differing chemical makeups).	Physical Science (9–12) A3: Develop an understanding of chemical reactions.	EP
AS-22	Internal/External Combustion The technician can demonstrate an understanding of how fuel characteristics affect combustion in an automotive engine.	Physical Science (9–12) A3: Develop an understanding of chemical reactions.	EP
AS-23	Phases/States The technician can explain in detail the three states of matter.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter.	HA
AS-24	Chemical Reactions The technician can demonstrate an understanding of the chemical reactions that occur in the automotive engine that are related to the combustion of fuels and the operation of the catalytic converter.	Physical Science (9–12) A3: Develop an understanding of chemical reactions.	BR, HA, EP
AS-25	Inhibitors The technician can explain the need for additives in automobile lubricants.		AT, MD, SS, HA, EP
AS-26	Temperature The technician can define heat and determine its affect in vehicle components by taking temperature readings.	Physical Science (9–12) A5: Develop an understanding of conservation of energy and the increase in disorder. A6: Develop an understanding of the interactions of energy and matter.	ER, AT, EL, HA, EP

AS-27	Heat The technician can demonstrate an understanding of the effect of heat on automotive systems.	Physical Science (9–12) A5: Develop an understanding of conservation of energy and the increase in disorder.	ER, AT, BR, EL, HA, EP
AS-28	Conduction/Convection The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in automotive systems.	Physical Science (9–12) A5: Develop an understanding of conservation of energy and the increase in disorder.	ER, AT, MD, EL, HA, EP
AS-29	Expansion/Contraction The technician is able to demonstrate an understanding of the expansion and contraction of system parts as a result of heat generated during the use of the system.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter.	ER, AT, MD, SS, EL, HA, EP
AS-30	Fusion/Vaporization The technician can demonstrate an understanding of how heat causes a change in the state of matter.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter.	ER, AT, MD, HA, EP
AS-31	Insulation The technician can explain the role of insulation in maintaining temperatures.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter.	ER, EL, HA, EP
AS-32	Radiation The technician can demonstrate an understanding of heat transfer that involves infrared rays.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, HA, EP
AS-33	Refraction The technician can demonstrate an understanding of refraction as it occurs in systems that employ fiber optics.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter.	EL
AS-34	Ultraviolet The technician can demonstrate an understanding of why dyes added to lubricants fluoresce in ultraviolet light.	Physical Science (9–12) A3: Develop an understanding of chemical reactions.	ER, AT, MD, HA
AS-35	Ultraviolet The technician can demonstrate a process for determining the source of leakage using ultraviolet light.	Physical Science (9–12) A3: Develop an understanding of chemical reactions.	HA
AS-36	Sound The technician can demonstrate an understanding of the role sound plays in identifying various problems in the vehicle.		ER, AT, MD, SS, BR, EL, EP
AS-37	Vibrations/Waves The technician can demonstrate an understanding of the types and causes of vibrations caused by out-of-balance or excessively worn systems.		ER, AT, MD, SS, BR, EL, HA, EP

AS-38	Amplification The technician can explain to a customer how sound can be amplified in a vehicle due to resonant cavities and other physical characteristics of the vehicle.		ER, AT, MD, SS, BR, EL, EP
AS-39	Carriers/Insulators The technician can demonstrate an understanding of how sound generated in one place can be carried to other parts of the body or engine through metal and other materials.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter.	ER, AT, MD, SS, BR, HA, EP
AS-40	Decibels/Intensity The technician can demonstrate an understanding of how sound intensity can be measured.		ER, AT, MD, SS, BR, HA, EP
AS-41	Frequency – Hertz The technician can explain how frequency of a sound can be used to identify normal and abnormal operating systems.		ER, AT, MD, SS, BR, EL, HA, EP
AS-42	Hearing The technician can demonstrate an understanding of the role of listening for unusual sounds as part of the troubleshooting process.		AT, MD, SS, BR, HA, EP
AS-43	Noise/Acoustics The technician can demonstrate an understanding of why the acoustics of the vehicle affect specific noises.		ER, AT, MD, SS, BR, HA, EP
AS-44	Overtones/Harmonics The technician can explain that the presence of overtones may indicate changes in vibrations in systems.		ER, AT, MD, SS, BR, HA, EP
AS-45	Pitch/Frequency The technician can explain the relationship of pitch to frequency.		ER, AT, MD, SS, BR, HA, EP
AS-46	Resonance The technician can demonstrate an understanding of what happens when an object resonates.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-47	Force, Balanced/ Unbalanced The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating vehicle assemblies.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, BR

AS-48	Centrifugal/Centripetal The technician can explain the relationship of centrifugal/centripetal force to the functioning or failure of a rotating system.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, MD, HA
AS-49	Pressure The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	AT, MD, HA, EP
AS-50	Work The technician can explain the relationship between torque and horsepower.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	AT, MD, EP
AS-51	Acceleration/Deceleration The technician can demonstrate an understanding of a vehicle's acceleration and deceleration as a function of vehicle weight and power.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	AT, MD, BR, EP
AS-52	Circular The technician can demonstrate an understanding of circular motion as it relates to changes in toe and camber on turns.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	AT, MD, EP
AS-53	Electricity The technician can demonstrate an understanding of and explain the properties of electricity as they relate to lighting, engine management, and other electrical systems in the vehicle.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter. A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-54	Batteries The technician can demonstrate an understanding of the electrochemical reactions that occur in wet-cell and dry-cell batteries.	Physical Science (9–12) A3: Develop an understanding of chemical reactions. A6: Develop an understanding of the interactions of energy and matter.	AT, EL, HA, EP
AS-55	Acids/Bases The technician can identify the effects of the pH of a solution on various systems.	Physical Science (9–12) A3: Develop an understanding of chemical reactions.	AT, MD, EL, EP
AS-56	Density/Specific Gravity The technician can explain the role of specific gravity in determining the condition of the system.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter.	ER, EL, EP
AS-57	Conductors The technician can explain the difference between an electrical conductor and an insulator.	Physical Science (9–12) A2: Develop an understanding of the structure and properties of matter. A6: Develop an understanding of the interactions of energy and matter.	ER, AT, BR, HA, EP
AS-58	AC-DC The technician can explain the difference between direct and alternating current.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP

AS-59	Ground The technician can demonstrate an understanding of the characteristics of a quality electrical ground.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-60	Ground The technician can demonstrate an understanding of the problems associated with having an electrical circuit inadequately grounded.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-61	Parallel/Series Circuits The technician can explain current flow and voltage in series and parallel circuits.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-62	Short Circuit The technician can demonstrate an understanding of the processes used to locate a short circuit in an electrical/electronic system.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-63	Generators The technician can explain how the movement of a conductor in a magnetic field will generate electricity.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, BR, EL, HA, EP
AS-64	Motors The technician can demonstrate an understanding of the role of the generator/alternator in maintaining battery and system voltage.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	BR, EL, EP
AS-65	Transformers The technician can explain the ignition coil transformer's role in generating the high voltage required to fire a spark plug.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	EL, HA, EP
AS-66	Electricity—Measurement The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, and resistance.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-67	Ammeter/Voltmeter The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-68	Electrical The technician can use precision electrical test equipment to measure current, voltage, and resistance.		ER, AT, MD, SS, BR, EL, HA, EP

AS-69	Fuse The technician can explain the role of a fuse or fusible link as a protective device in an electrical or electronic circuit.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, EL, HA, EP
AS-70	Ohm's Law The technician can demonstrate an understanding of and explain the use of Ohm's Law in verifying circuit parameters (resistance, voltage, amperage).	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, BR, EL, HA, EP
AS-71	Resistance The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, BR, EL, HA, EP
AS-72	Voltage The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, BR, EL, HA, EP
AS-73	Electrochemical Reactions The technician can demonstrate an understanding of the ion transfer process that occurs in an automotive battery.	Physical Science (9–12) A3: Develop an understanding of chemical reactions. A6: Develop an understanding of the interactions of energy and matter.	EL, EP
AS-74	Activity of Metals The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-75	Electromagnetism The technician can explain the relationship between current in a conductor and strength of the magnetic field.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-76	Coil The technician can explain how a coil can increase the battery voltage needed to fire a spark plug.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, EL, HA, EP
AS-77	Capacitance The technician can demonstrate an understanding of the role of capacitance in timer circuits such as RC timers or a MAP sensor.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	BR, EL, EP
AS-78	Magnetic Fields/Force The technician can explain the effect of magnetic fields on unshielded circuits in control modules.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP

AS-79	Semiconductor Devices The technician can demonstrate an understanding of the capability of semiconductor devices to rapidly modify engine operation parameters.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, MD, SS, BR, EL, HA, EP
AS-80	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 operation.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, AT, BR, EL, HA, EP
AS-81	Photocells The technician can demonstrate an understanding of the purpose of photocells.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	ER, EL, HA, EP
AS-82	Photocells The technician can demonstrate the measurement processes used to determine the output of photocells.	Physical Science (9–12) A6: Develop an understanding of the interactions of energy and matter.	EL
AS-83	Barometric Pressure The technician can demonstrate an understanding of the relationship of barometric pressure to engine performance.		ER, EL, HA, EP
AS-84	Relative Humidity The technician can demonstrate an understanding of and discuss relative humidity in terms of its effect on automotive heating and air conditioning systems.		ER, EL, HA, EP
AS-85	Problem Solving The technician can use computers, scan tools, and on-board data to diagnose problems.		ER, EL, HA, EP
AS-86	Action/Reaction The technician can demonstrate an understanding of the action/reaction of fluids involving valves or pistons.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	AT, MD, SS, BR, EP
AS-87	Hydraulics The technician can explain how fluid pressure transmits force from one location to another.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR, EL, HA, EP
AS-88	Pneumatics The technician can demonstrate an understanding of the forces and motions in pneumatic systems.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, HA, EP

AS-89	Ions The technician can explain the principles by which a catalytic converter modifies emission gases at the atomic level to provide a lower level of HC, CO, and NOx in the final exhaust.	Physical Science (9–12) A3: Develop an understanding of chemical reactions.	EL, EP
AS-90	Friction The technician can demonstrate an understanding of friction and its effects on linear and rotational motion.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR, HA, EP
AS-91	Friction The technician can explain the role that friction plays in acceleration and deceleration.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR, HA, EP
AS-92	Friction The technician can explain the need for lubrication to minimize friction.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR, HA, EP
AS-93	Metallurgy The technician can explain the critical need for metals of different hardnesses in automotive parts.		ER, AT, MD, BR, EP
AS-94	Dynamics The technician can explain the forces and motions involved in a hydraulic system.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, BR, HA, EP
AS-95	Surface Process (Absorption/Adsorption) The technician can explain the surface process that occurs on system seals due to absorption of the contained materials.		ER, AT, MD, SS, BR, EL, EP
AS-96	Contamination The technician can demonstrate an understanding of how a contaminated liquid can cause a chemical reaction that results in the deterioration of performance.	Physical Science (9–12) A3: Develop an understanding of chemical reactions.	ER, AT, MD, SS, BR, EL, EP
AS-97	Torque The technician can demonstrate an understanding of how torque relates to force and angular acceleration.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR, HA
AS-98	Simple Machines The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or change the direction of force in a mechanical system.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR

AS-99	Rotational The technician can explain how rotational motion can be converted to linear motion and why balance is important in rotating systems.	Physical Science (9–12) A4: Develop an understanding of motions and forces.	ER, AT, MD, SS, BR, EP
AS-100	Flow Rate The technician can demonstrate an understanding of how variances in flow rate in airflow sensors and cooling systems can affect engine performance.	Physical Science (9–12) A3: Develop an understanding of chemical reactions.	ER,HA, EP
AS-101	Proportion Mixtures The technician can correctly mix fluids using proportions.		AT, MD, SS, BR, HA
AS-102	Adhesives/Sealants The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces determine the effectiveness of glues, tapes, and sealants.		ER, AT, MD, EL, HA, EP
AS-103	Viscosity The technician can demonstrate an understanding of fluid viscosity as a measurement and explain how it impacts engine performance.		ER, AT, MD, SS, EP

Applications in the Preparation of Automotive Technicians

The information contained in this document has several practical applications in the development of a course of study designed to prepare automotive technicians.

For automotive instructors, the information contained herein emphasizes the importance of communications, math and science in preparing automotive technicians for the future. Servicing today's highly sophisticated automotive vehicle requires a unique blend of head and hand skills. While the NATEF tasks list identifies the important manipulative skills, the information in this document emphasizes the cognitive skills that technicians must know and understand in order to be successful in their chosen vocation.

Teachers of English, mathematics and science can use this information to demonstrate the significance of their respective disciplines and their applications in the every day work world.

The information can also be used by educational administrators, curriculum designers, assessment specialists, and teacher committees to:

- Plan integrated automotive technician/academic courses of study;
- Determine the division of teaching tasks based on course of study content and teacher credentials;
- Prepare and administer competency-based multiple assessment strategies;
- Audit integrated course content to determine the merits of awarding academic credit to learners enrolled in an integrated automotive technology program; ■
- Craft articulation agreements
- Design and present professional development sessions on academic/automotive technology integrated curricula.



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