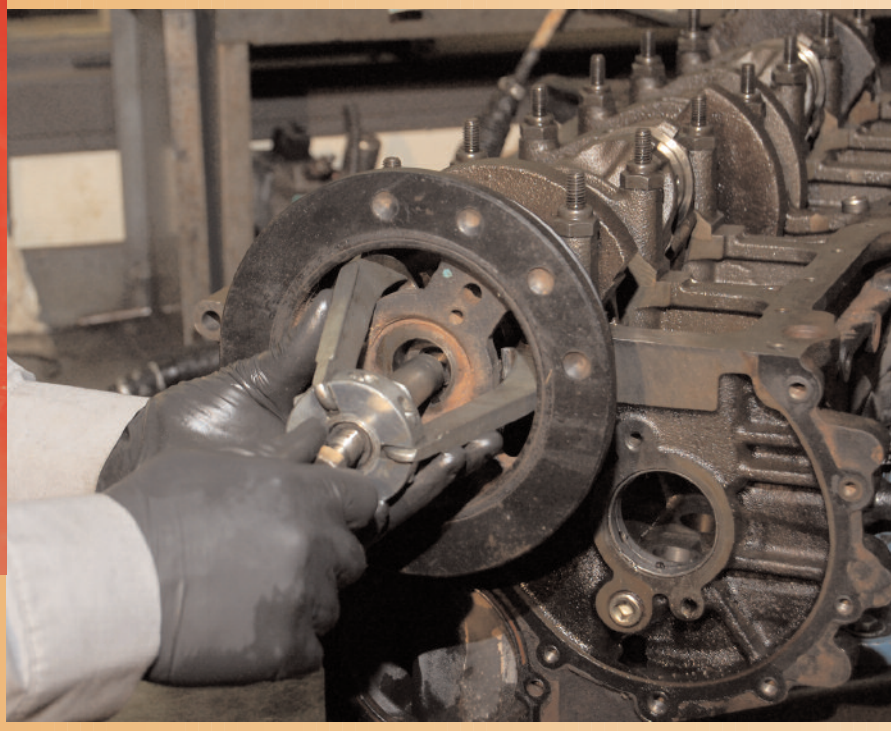
Tools of the Trade



Inside the Automotive Technician's Toolbox

SHOPWARE

Instructor's Guide

Introduction

This instructor's guide provides information to help you get the most out of *Inside the Automotive Technician's Toolbox*, part of the *Tools of the Trade* series. The contents of this guide will allow you to prepare your students before they use the program, assist them as they navigate through the program, and present follow-up activities to reinforce the program's key learning points.

Tools of the Trade is a 6-part series of programs that present inventories of the most common and most basic tools used in specific trades. Each program opens the trade's "toolbox" so students can delve into its basic tools and materials, including their purpose and proper usage. Students will view brief demonstrations of rudimentary tasks with the tools, and gain an understanding of safety precautions, code concerns, and industry tips, if applicable.

Inside the Automotive Technician's Toolbox is a 32-minute video targeted to students (vocational students, in particular) in grades 9-12. Its content is appropriate to such curriculum areas as Technology Education, Trade, and Industrial Education. In addition, the information presented in *Tools of the Trade* could also be presented in vocational/technical schools or "Do it Yourself" adult education courses.

The *Tools of the Trade* series consists of the following titles:

- *Inside the Plumber's Toolbox*
- *Inside the Carpenter's Toolbox*
- *Inside the Mason's Toolbox*
- *Inside the Welder's Toolbox*
- *Inside the Automotive Technician's Toolbox*
- *Inside the Electrician's Toolbox*

Learning Objectives

After watching this video program, students will be able to:

- Identify and understand basic safety standards used when performing auto repair.
- Identify and understand the core areas of systems competencies within the auto repair certificate (Electrical, Engine, Steering/Suspension, Brakes).
- Identify and understand the tools used in basic level repairs on the core automobile systems.
- Be able to explore and analyze auto repair career opportunities.

Educational Standards

Inside the Automotive Technician's Toolbox correlates with the following standards:

- The competency standards for Core Introductory Craft Skills from the National Center for Construction Education & Research (NCCER);
- The NOCTI/SkillsUSA Examination Standards;
- The standards for Basic Skills (Mathematics) and Thinking Skills (Visualization) from the Secretary's Commission on Achieving Necessary Skills (SCANS);
- The standards of Essential Knowledge and Skills for Trade and Skills for Career Orientation, High School, for the State of Texas;
- The standards of Technology Education—Tools, Resources, and Technological Processes, for the State of New York.

- Standard 16.0 Career Cluster: Transportation, Distribution and Logistics Planning, management, and movement of people, materials, and goods by road, pipeline, air, rail and water and related professional and technical support services such as transportation infrastructure planning and management, logistics services, mobile equipment and facility maintenance.

- INTRODUCTION TO BLUEPRINTS (MODULE 00105-00). The student is able to recognize and identify basic blueprint terms, components, and symbols; relate information on blueprints to actual locations on the print; recognize different classifications of drawings; and interpret and use drawing dimensions.

- COMMUNICATION SKILLS (MODULE 00107-04). The student is able to demonstrate the ability to understand information and instructions that are presented in both written and verbal form; and demonstrate the ability to communicate effectively in on-the-job situations using written and verbal skills.

Source: Competency Standards for Core Curriculum and Carpentry from the National Center for Construction Education & Research.

- Standard: The student analyzes the effect of personal interests and aptitudes upon educational and career planning, and knows how to locate, analyze, and apply career information.

Source: Texas State Standards: Essential Knowledge and Skills for Trade and Skills for Career Orientation, High School.

- Standard: The student applies technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs. The student: uses a variety of materials and energy sources to construct things; understands the importance of safety and ease of use in selecting tools and resources for a specific purpose; and develops basic skills in the use of hand tools.

Source: New York State Standards on Technology Education: Tools, Resources, and Technological Processes.

National Standards English Language Arts Standards

The activities in this guide were created in compliance with the following National Standards for the English Language Arts from the National Council of Teachers of English.

- 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 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.

Using these standards, the ASE/NATEF organizations have compiled the following list of language arts and communication skills for automotive service personnel. Using these skills, an automotive technician must be able to:

- Request, collect, comprehend, evaluate, and apply oral and written information gathered from customers, associates, and supervisors regarding problem symptoms and potential solutions to problems.

- Identify the purpose for all written and oral communication and then choose the most effective strategies for listening, reading, speaking, and writing to facilitate the communication process.
- Adapt a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, etc., relevant to problem identification, diagnosis, solution, and repair.
- Attend to verbal and nonverbal cues in discussions with customers, supervisors, and associates to verify, identify, and solve problems.
- Use study habits and techniques, i.e. previewing, scanning, skimming, taking notes, etc., when reviewing publications (shop manuals, references, databases, operator's manuals, and text resources) for problem solving, diagnosis, and repair.
- Use prior knowledge learned from solving similar problems to diagnose and repair specific problems.
- Write clear, concise, complete, and grammatically accurate sentences and paragraphs.
- Write warranty reports and work orders to include information regarding problem resolution and the results of the work performed for the customer or manufacturer.
- Comprehend and apply industry definitions and specifications to diagnose and solve problems in all automotive systems and components.
- Follow all oral/written directions that relate to the task or system under study.
- Comprehend and use problem-solving techniques and decision trees that are contained in service manuals to determine cause-and-effect relationships.
- Scan service manuals and databases to locate specific information for problem-solving purposes.
- Use the service manual to identify the manufacturer's specifications for system parameters, operation, and potential malfunctions.
- Interpret charts, tables, or graphs to determine the manufacturer's specifications for system operation to identify out-of-tolerance systems and subsystems.
- Supply clarifying information to customers, associates, parts suppliers, and supervisors.
- Use English and metric angle and distance measurements and techniques to determine parallel lines, perpendicular lines, and angle variances from the manufacturer's specifications.
- Visually perceive the geometric relationship of systems and subsystems that require alignment.
- Use formulas to indirectly confirm that systems are outside of the manufacturer's specifications.
- Follow all safety regulations and procedures while performing any task.

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National Technology Standards

The activities in this guide were created in compliance with the following National Education Technology Standards from the National Education Technology Standards Project.

- Students demonstrate a sound understanding of the nature and operation of technology systems.
- Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.
- Students use technology tools to enhance learning, increase productivity, and promote creativity.
- Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
- Students employ technology in the development of strategies for solving problems in the real world.

The National Education Technology Standards reprinted with permission from the International Society of Technology Education.

- Standard Number: N.SCANS.1.17. The student is able to: imagine building, object or system by looking at a blueprint or drawing.

Source: Secretary's Commission on Achieving Necessary Skills (SCANS) Thinking Skills (Visualization)

Technology Standards

The activities in this guide were created in compliance with the following National Education Technology Standards from the National Education Technology Standards Project. The content has been aligned with the following educational standards and benchmarks:

- Be proficient in the use of technology.
- Use technology tools to enhance learning, increase productivity, and promote creativity.
- Use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.
- Use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
- Use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
- Use technology to locate, evaluate, and collect information from a variety of sources.

The National Education Technology Standards reprinted with permission from the International Society for Technology Education.

National Automotive Technicians Education Foundation (NATEF) COLLISION REPAIR & REFINISH STANDARDS STATEMENTS

- STANDARD 1 – The collision repair and refinish technician training program should have clearly stated program goals, related to the needs of the students and employers served.
- STANDARD 2 – Program administration should ensure that instructional activities support and promote the goals of the program.
- STANDARD 3 – Support material, consistent with both program goals and performance objectives, should be available to staff and students.
- STANDARD 6 – Instruction must be systematic and reflect program goals. A task list and specific performance objectives with criterion referenced measures must be used.
- STANDARD 7 – Equipment and tools used must be of the type and quality found in the repair industry and must also be the type needed to provide training to meet the program goals and performance objectives.
- STANDARD 8 – The physical facilities must be adequate to permit achievement of the program goals and performance objectives.
- STANDARD 9 – The instructional staff must have technical competency and meet all state and local requirements for certification.
- Standard 3.1 – Service Information Service information with current manufacturer's service procedures and specification data for vehicles manufactured within the last ten (10) years should be available. This information should be accessible to students while working in the lab/shop area.
- Standard 3.2 – Multimedia Appropriate up-to-date multimedia materials such as video equipment, transparencies, etc. should be readily available and utilized in the training process.
- Standard 3.4 – Periodicals Current general and technical collision repair and refinish magazines and newspapers should be available for student and instructor use.
- Standard 3.5 – Student Materials Necessary instructional texts or pertinent material should be available for each student to satisfy the objectives of the mode of instruction used. Basic textbooks should have copyright dates that are not over five (5) years old; specialized textbooks should have copyright dates that are not over three (3) years old.
- Standard 6.1 – Program Plan The training plan should progress in logical steps, provide for alternate sequences where applicable, and be made available to each student.
- Standard 6.2 – Student Training Plan A training plan for each student should be used indicating the student's training goal(s) and specific steps needed to meet that goal.
- Standard 6.4 – Teaching Load The instructor/student ratio and class contact hours should allow time for interaction on a one-to-one basis.
- Standard 6.5 – Curriculum All tasks have been given a priority rating. At least 95% of the High Priority—Individual (HP-I) and 90% of the High Priority—Group (HP-G) items in the Task List must be included in the curriculum. Additional tasks may be included to meet the needs of local employers. The Advisory Committee should approve all additional tasks. Instruction on the legal aspects and responsibilities of the collision repair and refinish technician in areas such as Environmental Protection Agency regulations, safety regula-

tions, OSHA regulations (including the ruling on respiratory protection), and other appropriate requirements should be included in the curriculum. Instruction and practice in filling out work order forms, ordering parts, and basic record keeping should be a part of the training program. Tools and equipment must be available to perform the tasks in each of the areas in which certification is requested.

- Standard 6.7 – Performance Standards All instruction should be performance based, with an acceptable performance standard stated for each task. These standards should be shared with students and potential employers. Students should demonstrate "hands-on competency" or "mastery" of a task before the instructor verifies a student's performance.
- Standard 6.8 – Safety Standards Safety instruction should be given prior to lab/shop work and be an integral part of the training program. A safety test should be included in the training program. Students and instructors should comply with personal and environmental safety practices associated with clothing; respiratory protection; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
- Standard 6.14 – Evaluation of Instruction Instructional procedures should be evaluated in a systematic manner. This evaluation should be through regular reviews by students and the administration. Self-evaluation of instruction should also be utilized on a systematic and regular basis. This system should include input from former students and from the Advisory Committee members. Instructional procedures should show responsiveness to the feedback from these evaluations.
- Standard 7.1 – Safety Equipment and tools used in the training program must have all shields, guards, and other safety devices in place, operable, and used. Safety glasses must be worn by all students, instructors, and visitors in the lab/shop area while lab is in session.
- Standard 7.2 – Quantity and Quality The tools and equipment used in the training program should reflect the program goals and performance objectives. Sufficient tools and equipment should be available for the training offered. The tools and equipment should meet industry quality standards.
- Standard 7.5 – Replacement A systematic schedule for replacement should be used to maintain up-to-date tools and equipment at industry and safety standards. Student follow-up and Advisory Committee input should be used in this system.
- Standard 8.2 – Safety The facilities should meet all applicable safety standards and an emergency plan should be in place and posted in all classrooms and lab/shops areas.
- Standard 8.3 – Maintenance A regular facilities maintenance program should be used to assure facilities are suitable when required for instruction.
- Standard 9.1 – Technical Competency The instructor must hold current ASE certification in each collision repair and refinish area they teach and which is being evaluated for program certification.
- Standard 9.2 – Instructional Competency/Certification Instructors should meet all state certifying requirements.
- Standard 9.3 – Technical Updating Faculty members should be provided technical materials required to maintain their competency. An opportunity should be provided for instructors to return to industry on a regular basis for in-service and skill upgrading.
- Standard 9.4 – First Aid The program should have a written policy, approved by the administrator of the school, on First Aid procedures.

IHS Global Engineering Standards (Automotive)

- GME3191 – Electrical Connectors
- GMW3172 – General Specification for Electrical/Electronic Component
- Analytical/Development/Validation (A/D/V) Procedures for Conformance to Vehicle Environmental, Reliability, Durability, and Performance Requirements
- GMW3097 – General Specification for Electrical/Electronic Components and Subsystems, Electromagnetic Compatibility (EMC)
- GMW3100 – General Specification for Electrical/Electronic Components and Subsystems; Electromagnetic Compatibility; Verification Part
- GMW3091 – General Specification for Vehicles, Electromagnetic Compatibility (EMC)

- GMW3094 – General Specification for Electrical/Electronic Components and Subsystems; Electromagnetic Compatibility; Verification Part
- NFPA 30A – Code for Motor Fuel Dispensing Facilities and Repair Garages
- Q7-K – DaimlerChrysler, Ford Motor Company, and General Motors QS-9000 Quality Requirements 7 Pack (includes AIAG Manuals QS-9000, QSA, APQP, MSA, SPC, and FMEA)

Tools and Equipment
- Identify tools and their usage in automotive applications.
- Demonstrate safe handling and use of appropriate tools.
- Demonstrate proper cleaning, storage, and maintenance of tools and equipment.

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Career Standards

This program also correlates with the National Career Development Guidelines from the National Occupational Information Coordinating Committee. The content has been aligned with the following standards from this organization.
- Understand the relationship between educational achievement and career planning.
- Demonstrate how to apply academic and vocational skills to achieve personal goals.
- Describe the relationship of academic and vocational skills to personal interests.
- Describe how skills developed in academic and vocational programs relate to career goals.
- Describe how learning skills are required in the workplace.
- Locate, evaluate, and interpret career information.
- Describe the educational requirements of various occupations.
- Identify how employment trends relate to education and training.
- Demonstrate academic or vocational skills required for a full or part-time job.
- Demonstrate employability skills necessary to obtain and maintain jobs.
- Understand how societal needs and functions influence the nature and structure of work.
- Describe how occupational and industrial trends relate to training and employment.
- Describe career plans that reflect the importance of lifelong learning.
- Demonstrate knowledge of postsecondary vocational and academic programs.

The National Career Development Guidelines, reprinted with permission from the Center for Civic Education.

State Standards

This program correlates with the following State Standards: the Career Development and Occupational Studies from the State of New York; ImagineND from the State of North Dakota; and the Texas Essential Knowledge & Skills (TEKS) for Technology Education/Industrial Technology Education from the State of Texas.

New York State (Academy for Teaching and Learning: Career Development and Occupational Studies)
- Standard 1: Career Development. Students will be knowledgeable about the world of work, explore career options, and relate personal skills, aptitudes, and abilities to future career decisions.
- Standard 2: Integrated Learning. Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.
- Standard 3a: Universal Foundation Skills. Students will demonstrate mastery of the foundation skills and competencies essential for success in the workplace.
- Standard 3b: Career Majors. Students who choose a career major will acquire the career specific technical knowledge/skills necessary to progress toward gainful employment, career advancement, and success in postsecondary programs.

North Dakota State (ImagineND)

- Standard Number: N.16.0. Career Cluster: Transportation, Distribution and Logistics.
  Planning, management, and movement of people, materials, and goods by road, pipeline, air, rail and water and related professional and technical support services such as transportation infrastructure planning and management, logistics services, mobile equipment and facility maintenance.

Texas Essential Knowledge & Skills (TEKS) for Technology Education/Industrial Technology Education

• §123.45. Energy, Power, and Transportation Systems

(1) The student describes how a systems model can be used to describe energy, power, and transportation activities. The student is expected to: apply the universal systems model to energy, power, and transportation activities; identify the inputs, processes, outputs, and feedback associated with energy, power, and transportation systems; distinguish between various forms of energy; and describe how technological systems interact to achieve common goals.

(4) The student investigates emerging and innovative energy, power, and transportation technologies. The student is expected to: report on emerging and innovative energy, power, and transportation technologies; and conduct research and experimentation in energy, power, and transportation technology.

(5) The student describes quality and how it is measured in energy, power, and transportation.

(6) The student is expected to: describe different quality control applications in energy, power, and transportation; and apply continuous quality improvement techniques to the use and production of energy, power, and transportation.

(7) The student works safely with energy, power, and transportation technology. The student is expected to: master relevant safety tests; follow safety manuals, instructions, and requirements; identify and classify hazardous materials and wastes; and dispose of hazardous materials and wastes appropriately.

(8) The student describes the importance of maintenance in energy, power, and transportation. The student is expected to: handle and store tools and materials correctly; locate and perform manufacturers' maintenance procedures on selected tools, equipment, and machines; and describe the results of negligent or improper maintenance.

(10) The student applies the appropriate codes, laws, standards, or regulations related to energy, power, and transportation technology, such as Occupational Safety and Health Administration (OSHA), National Electrical Code (NEC), American Society for Testing Materials (ASTM), standard symbols, and line weight. The student is expected to: describe the importance of codes, laws, standards, or regulations; identify areas where codes, laws, standards, or regulations may be required; and follow the appropriate codes, laws, standards, or regulations.

(11) The student describes the intended and unintended effects of technological solutions. The student is expected to: use an assessment strategy to determine the risks and benefits of technological developments in energy, power, and transportation; describe how technology has affected individuals, societies, cultures, economies, and environments; discuss the international effects of energy, power, and transportation technology; and describe the issues related to regional and community planning and energy, power, and transportation.

(12) The student identifies the factors that influence the evolution of energy, power, and transportation technology. The student is expected to: describe how changes in energy, power, and transportation technology affect business and industry; describe how the development and use of energy, power, and transportation technology are influenced by past events; describe change and the factors that affect the adoption or rejection of energy, power, and transportation technology; and describe how and why technology evolves in energy, power, and transportation.

(13) The student solves problems, thinks critically, and makes decisions related to energy, power, and transportation technology. The student is expected to: develop or improve an energy, power, and transportation product or service by following a problem-solving strategy; apply critical-thinking strategies to the analysis and evaluation of proposed technological solutions; and apply decision-making techniques to the selection of technological solutions.

(15) The student applies his/her communication, mathematics, and science knowledge and skills to energy, power, and transportation activities. The student is expected to: use written, verbal, and visual communication techniques consistent with industry standards; use mathematics concepts in energy, power, and transportation technology; identify and apply science principles used in energy, power, and transportation technology; and use the appropriate units of measure.
(16) The student describes basic product and service marketing in energy, power, and transportation. The student is expected to: prepare a marketing plan for a(n) idea, product, or service; and discuss the effect of customer satisfaction on the image of a product or company.
(17) The student investigates career opportunities, requirements, and expectations in energy, power, and transportation technology. The student is expected to: identify an area of interest in energy, power, and transportation, and investigate its entry-level and advancement requirements and its growth potential; and describe the type of careers available in energy, power, and transportation technology.

Program Summary

Given the wide range of trades in the world today, the *Tools of the Trade* series is a welcome addition to the Shopware brand. Its overview and demonstration of the basic tools used in each trade help lay the foundation of understanding for the trades, and pique student interest in developing "do it yourself" practical knowledge that can also lead to "electrical" as a possible career choice.

Tools of the Trade: Inside the Automotive Technician's Toolbox provides an introductory level overview of the basic tools used in automotive repair and maintenance, and the related concepts dealing with safety standards and major auto systems repairs — including brakes, electrical, steering/suspension, and engine performance. The program is geared towards the basic automotive repair certificate student in either a Secondary or Post Secondary program.

Main Topics

Topic 1: Introduction
The program's host, Alan Pratt, introduces the viewer to the history of the automobile and explains why those who service and repair autos are called auto technicians instead of auto mechanics.

Topic 2: The Body of a Car
This topic takes an inside look — literally! — at both gas-powered vehicles and hybrid gas/electric-powered vehicles, so viewers can better understand what auto techs work on in their daily jobs.

Topic 3: Safety Considerations
The host reviews safety gear and safety precautions in and around auto repair shops. He also highlights some safety considerations that are specific to hybrid vehicles.

Topic 4: Basic Auto Tech Tools
This section is devoted to both the personal hand tools auto techs use in general when servicing vehicles and the maintenance and repair tools they use when working on specific vehicle components such as the engine, the brakes, and the electric and electronic systems.

Topic 5: Future Outlook
The program wraps up with the future outlook for automotive technician career opportunities and cites some helpful resources to turn to for more information.

Fast Facts

- Automotive service technicians must strive to keep up with the changing technology and repair techniques of newer and more sophisticated vehicle components and systems. Formal automotive technician training is key, and good diagnostic and problem-solving skills, combined with knowledge of electronics and good mathematical skills and mechanical aptitude, will add up to great opportunities for those seeking jobs as automotive technicians in the next decade.

- Who are the biggest employers of auto techs? With 29% each, automotive repair/maintenance shops and automotive dealers top the list. Seven percent are employed by automotive parts, accessories, and tire stores. Almost 17% of auto techs are self-employed.

- It is estimated that there will be roughly 31,900 new automotive service technician jobs available in the next decade, and automobile retailing jobs (not in service) are estimated to rise by 13% in that same time frame.

- Anyone interested in both cars and computer technology could find a great career as any of the following, just to name a few: Dealership Administrator, Detailer Foreman, Entry-level Service Technician, Fixed Operations Director, Lubrication Servicer, Mid-level Service Technician, Service Advisor, Shop Foreman, or Service Manager.

- Taiwan is quickly gaining an edge over Europe, Japan, and North America as a supplier for automotive hand tools. For example, Hwang Cherng Bin Specialty Tools Inc. offers an engine and transmission crane that has a magnetic holder capable of turning 360 degrees, making it easier for the technician to view and work on the parts. It also features foldable legs to save storage space.

- With a keyless entry security system, asset management software to organize from one to hundreds of tool cribs, and a tool control system, innovative storage systems like Snap-On offer the latest in tool storage and management solutions.

- From plastic cases and boxes, to metal roll-carts, cabinets, lockers, chests, and even tool utility vehicles (TEVs), an automotive service technician's toolbox can be customized to whatever the tech or his or her employer wants to use.

- It is estimated that more than 30 million new cars will ship with onboard telematics units (e.g., GM's OnStar or Ford's SYNC) in the next few years, making it likely that the communication/global positioning device will soon be a standard feature on new cars.

- Market research shows that the automotive electronics market could continue to reach roughly 9% annual growth over the next few years, especially in the areas of Driver Assistance (electronically controlled steering and suspension safety systems), Safety Systems, and Entertainment.

- Automotive technology continues to innovate, so auto techs must stay current to keep up with the latest trends and ideas. One such innovation is the Advanced Driver Assistance System, which offers lane-departure warning (LDW), adaptive headlight control, traffic-sign recognition, collision avoidance, and forward collision warning. It is hoped that the number of accidents can be greatly reduced by this technological automotive advancement.

Vocabulary Terms

Allen wrench: Also called a hex wrench, a tool used for tightening screws and fastenings that have odd shaped holes.

axle and hub pullers: Tools used to pull odd axles and hubs. An example is a slide hammer puller, used to pull off rear axles on a rear-wheel-drive vehicle.

battery cable terminal puller: A tool used to pull battery terminals without damaging the battery case.

battery hydrometer: A tool used to check for a full charge and equalized cells in a battery.

box wrench: A wrench having a closed, ring-like end designed to fit over a nut or bolt.

brake spoon: A tool used to adjust brakes.

brake spring pliers: A tool used to work on the hold-down springs.

braking recovery system: A system in a hybrid vehicle that sends electrical energy to the rechargeable batteries.

breaker bar: A long socket wrench handle providing greater leverage.

chisels: Tools used for repairing metal components and cutting into metal.

combination slip-joint pliers: A tool designed for gripping and turning round objects such as rods and pins.

combination wrench: A tool that has an open end on one side and a closed end on the other. Examples include the offset wrench and the ignition wrench.

compression gauge: A tool that measures cylinder pressure.

continuity tester: A tool used to check fuses. The tester is pulled out of its receptacle and hooked up to both blades of the fuse.

crescent wrench: Also called a monkey wrench, an adjustable tool designed to fit hexagonal nuts, with the adjusting screw built into the head of the wrench.

crowsfoot wrench: A specialty wrench used for loosening the hold-down bolt on the distributor.

diagonal cutting pliers: A tool used for cutting wires when working on the circuits of electrical systems.

digital multimeter: Also called a DVOM, it is a diagnostic tool that tests for problems and readings in the electrical system.

distributor wrench: A specialty wrench used to adjust the timing on a non-electronic car's ignition system.

electrician's pliers: A multipurpose tool used to splice, cut, or strip wires.

extender: An accessory that provides added reach to socket wrenches.

feeler gauge: Tool used to measure gap-widths.

files: Tools used to grind other tools back into their proper shape.

flat feeler gauge: Tool that allows you to measure and adjust valves and ignition contact points.

fluorescent droplights: Lights that feature a protective cage so the hot bulbs cannot be touched.

fuse puller: A tool used to remove and replace fuses safely.

gear puller: Tool used for stuck crankshaft gears or steering wheels.

graphic multimeter: Also known as a digital storage oscilloscope, it is a tool that captures and displays electrical signals and glitches.

lathe: A machine for shaping a piece of material, such as wood or metal, by rotating it rapidly along its axis while pressing against a fixed cutting or abrading tool.

line wrench: A specialty wrench used for working on fuel lines or brake lines. Also called a flare nut wrench.

lug wrench: A cross-shaft specialty wrench used for removing the wheel or lug nuts on a tire.

needle-nosed pliers: Also known as long-nose pliers or pinch nose pliers, this tool is used for cutting and gripping, as well as for bending, re-positioning, and cutting wire.

oil filter wrench: A specialty wrench used for removing oil filters.

open-end wrench: A wrench having fixed, open jaws on one or both ends.

punch: Tool that allows you to you dimple metal prior to drilling into it.

return spring tool: A tool used on drum brakes to remove and install the return springs.

scan tool: A diagnostic tool that processes and displays vehicle data link information.

screwdrivers: Available in flat, Phillips, and torx (which are used on torx fasteners on headlights or in car interiors), they are used to hold and tighten screws.

side-cutting pliers: A tool used to cut wires when working on the circuits of electrical systems.

slip-joint pliers: A tool with a joint adjustable to two positions in order to increase the opening of the jaws.

sockets: Available in two designs (standard and deep), and in three categories (hand sockets for hand tools; impact sockets, which can be used on hand tools or impact tools; and power sockets, for power nut runners or multi-spindle machines usually found in production), these are openings into which the inserted parts of socket wrenches are designed to fit.

socket wrenches: Tools that are similar to open-end wrenches but which have ratcheting drive handles.

speeder: A tool used to crank oil pan bolts quickly.

standard measurements: Also known as Society of Automotive Engineers or SAE measurements, these are the measurements used mainly in foreign vehicles.

tappet wrench: A tool that has a long, thin handle to assist in adjusting valves.

torque angle gauge: A tool used for torque-to-yield fastener applications.

torque wrench: Similar to a socket wrench, it is a tool used for tightening nuts and fasteners to an exact degree.

wire terminal brush: A tool used to clean corroded battery terminals.

Pre-Program Discussion Questions

1. Is anyone familiar with the history of the automobile? When and by whom was the first modern-day automobile created? When was the first garage opened for servicing cars?

2. What tasks do you think auto techs do on a day-to-day basis? Can you name any specialties in auto repair and service?

3. What are some ways to protect your investment when you have purchased personal hand tools?

4. Can you name the main systems in a typical gas-powered vehicle? What is the function of each system? What are the main systems in a typical hybrid vehicle? How do they work together?

5. Can anyone name the two measurement systems used for car engines? Why do you think the difference is important?

Post-Program Discussion Questions

1. What is the difference between braking in a gas-powered vehicle and braking in a hybrid vehicle? What is regenerative braking?

2. What are some of the potential hazards in and around a repair shop? Why is it important to use a clean rag each and every time you start on a new automotive task? What important safety tips should you remember about extension cords and fluorescent droplights?

3. What are three key areas in a hybrid vehicle when it comes to safety? What safety concerns are important to remember in each area?

4. Name the two kinds of socket designs and the three categories of sockets available. What kinds of accessories can you use with socket wrenches?

5. Why do you think now would be a good time to enter the automotive service field? What courses of study do you think would be the most beneficial given current and potential technologies?

Individual Student Projects

- Gather an assortment of various tools and place them on a center table in the middle of a class, on a numbered grid. Ask students to identify each tool by its grid number. Discuss the use of each tool and what systems it is used to work on.

- Research tools used when working on drum brakes, and compare them to the tools used on disc brakes. Create a spreadsheet that lists common tools used on each, and then write a synopsis of how the tasks and tools differ, depending on the brake type.

- What is the difference between measurement systems used on domestic car engines and those on foreign car engines? Explain your findings, citing specific examples of each.

Group Activities

- Divide into small groups and assign each group a system in either a gas-powered or hybrid car. Make a poster of the system, labeling all components. Include what auto repair and maintenance tasks are performed on the system and what hand and specialty tools are used in the process.

- Perform safety skits. Simulate behaviors and practices that would be considered unsafe in an automotive repair shop and ask the class to correct the actions, citing proper corrective action in each case.

- After completing the second group activity, create safety posters, with each poster devoted to a specific category: hybrid safety, safety gear, safety practices around the shop, safety considerations around water, etc. Include photos and safety tips, where appropriate.

Internet Activities

- Research the history of the automobile and automotive repair. Trace what the effect was when advancements in technology occurred in the industry, choosing key moments in your timeline.

- What innovations are on the cutting edge of today's (and tomorrow's) automotive tool technologies? What makes them so revolutionary? Include relevant photos and reviews to support your statements.

- How has auto repair evolved in the past ten years (include information on hybrid autos)? How about in just the past 5 years? How do you expect it to change in the next 5 years, 10 years, and 100 years? Write a report or create a presentation to be given in front of the class.

Assessment Questions

Q1: What's the threshold for voltage that can be fatal? (Select the best answer.)

a) 20 b) 40 c) 60 d) 80

Q2: True or False: A dead hybrid battery can still have 300 volts in it.

Q3: What chemical mixture do the cells in a typical hybrid vehicle battery pack contain?

a) Lead b) Lead-acid c) Nickel d) Nickel metal hydride

Q4: True or False: You should use your ears to determine if a hybrid vehicle is still powered on.

Q5: Choose the correct term: A(n) **compression / internal combustion / spark engine** creates power by burning a mixture of fuel and air. A(n) **compression / internal combustion / spark engine** uses an ignition system to start the fire and gasoline, propane, or natural gas as the fuel in the mixture. A(n) **compression / internal combustion / spark engine** uses heat and pressure to ignite the mixture of air and diesel fuel.

Q6: Spark plugs are available in how many sizes?

a) 0 b) 1 c) 2 d) 3 e) 4

Q7: Match each type of wrench with its corresponding description.

a) Allen
b) Crescent
c) Cross-shaft lug
d) Crowsfoot
e) Distributor
f) Line
g) Socket
h) Tappet
i) Torque

1) Used to adjust the timing on a non-electronic car's ignition system.
2) Also called "monkey wrenches," they are good for fitting into tight spaces.
3) Also called hex wrenches, they are ideal for the screws and fastenings that have odd shaped holes.
4) Have long, thin handles to assist in adjusting valves.
5) Loosen the hold-down bolt on the distributor.
6) Similar to open-end wrenches but have ratcheting drive handles.
7) Tighten nuts and fasteners to an exact degree but can be slightly bulky.
8) Sometimes called flare nut wrenches, they are for working on fuel lines or brake lines.
9) Used to remove the wheel or lug nuts on a tire.

Q8: Which tool is used for turning nuts and bolts? (Select all that apply.)

a) Hammers b) Pliers c) Wrenches d) None of these.

Q9: True or False: You can use screwdrivers instead of chisels with your hammer if your chisel has become mushroomed from extended use.

Q10: True or False: A continuity tester lets you check for a full charge and equalized cells.

Assessment Questions Answer Key

Q1: What's the threshold for voltage that can be fatal? (Select the best answer.)
a) 20 b) 40 c) 60 d) 80
A1: *The correct answer is (c).*

Q2: True or False: A dead hybrid battery can still have 300 volts in it.
A2: *This statement is true.*

Q3: What chemical mixture do the cells in a typical hybrid vehicle battery pack contain?
a) Lead b) Lead-acid c) Nickel d) Nickel metal hydride
A3: *The correct answer is (d).*

Q4: True or False: You should use your ears to determine if a hybrid vehicle is still powered on.
A4: *This statement is false.*

Q5: Choose the correct term: A(n) **compression / internal combustion / spark engine** creates power by burning a mixture of fuel and air. A(n) **compression / internal combustion / spark engine** uses an ignition system to start the fire and gasoline, propane, or natural gas as the fuel in the mixture. A(n) **compression / internal combustion / spark engine** uses heat and pressure to ignite the mixture of air and diesel fuel.
A5: *An **internal combustion** engine creates power by burning a mixture of fuel and air. A **spark engine** uses an ignition system to start the fire and gasoline, propane, or natural gas as the fuel in the mixture. A **compression** engine uses heat and pressure to ignite the mixture of air and diesel fuel.*

Q6: Spark plugs are available in how many sizes?
a) 0 b) 1 c) 2 d) 3 e) 4
A6: *The correct answer is (c).*

Q7: Match each type of wrench with its corresponding description.

a) Allen
b) Crescent
c) Cross-shaft lug
d) Crowsfoot
e) Distributor
f) Line
g) Socket
h) Tappet
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1) Used to adjust the timing on a non-electronic car's ignition system.
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7) Tighten nuts and fasteners to an exact degree but can be slightly bulky.
8) Sometimes called flare nut wrenches, they are for working on fuel lines or brake lines.
9) Used to remove the wheel or lug nuts on a tire.

A7: The correct answers are: 1(e); 2(b); 3(a); 4(h); 5(d); 6 (g); 7(i); 8(f); 9(c)

Q8: Which tool is used for turning nuts and bolts? (Select all that apply.)

a) Hammers
b) Pliers
c) Wrenches
d) None of these.

A8: *The correct answer is (c).*

Q9: True or False: You can use screwdrivers instead of chisels with your hammer if your chisel has become mushroomed from extended use.

A9: *This statement is false.*

Q10: True or False: A continuity tester lets you check for a full charge and equalized cells.

A10: *This statement is false. A battery hydrometer lets you check for a full charge and equalized cells. A fuse is checked by pulling it out of its receptacle and hooking up a continuity tester to both blades of the fuse.*

Additional Resources

About.Com
autorepair.about.com

Auto Body Online
www.autobodyonline.com

Autobody Pro
www.autobodypro.com

Auto Body Toolmart Repair and Restoration Tutorials
www.autobodytoolmart.com/restorations.html

Automotive Body Repair News
www.abrn.com

Automotive Youth Educational Systems (AYES)
www.ayes.org

Bureau of Labor Statistics—Automotive Body and Related Repairers
www.bls.gov/oco/ocos180.htm

Hybrid Cars
www.hybridcars.com

I-car
www.i-car.com

National Automobile Dealers Association Ethics Guide
www.nada.org

National Automotive Service Task Force
www.nastf.org

National Automotive Technicians Education Foundation
www.natef.org

National Institute for Automotive Service Excellence
www.asecert.org

SkillsUSA
www.skillsusa.org

Vocational Information Center: Auto Body Career Resources
www.khake.com/page11.html

Additional Resources at www.films.com

Available from Films Media Group • www.films.com • 1-800-257-5126

Automotive Computer Systems

• VHS/DVD
• Preview clip online
• Closed captioned
• Includes viewable/printable instructor's guide
• Correlates to standards
• Order #24743

This series provides a basic working knowledge of automotive computer systems. Your students will learn: • computer system operation • trouble codes • scanning tools • basic tests • repair procedures. Ford, General Motors, Chrysler, and other makes are discussed. The *Computer Systems* series videos stand alone or can be used as a set for beginning auto technician students as well as for more advanced classes. The series includes *Automotive Computer System Operation; Computer On-Board Diagnostics; Automotive Computer System Service; Scanning Automotive Computer Problems.* A Shopware Production. (29 minutes each) © 2008

Automotive Engines

• VHS/DVD
• Preview clip online
• Closed captioned
• Correlates to standards
• Order #24751

At the heart of every automobile is the engine...and this series of videos not only explains the basic operating principles, but provides clear instruction for maintenance and repair. Using close ups of actual working parts along with computer animation, this set of 8 videos covers every major part of a gasoline-driven engine. Each video summarizes the operation and construction of related components as well as demonstrating many important techniques for troubleshooting problems and the best methods for repair. Parts reviewed: • crankshaft • rings • belts • timing chains • gaskets • gears • block • rods • cylinder head • valves • intake manifold • cams • main bearings • pistons • seals. These videos also demonstrate how to inspect, organize, and measure engine parts...check for damage...how to disassemble and reassemble an engine...and briefly covers some machine shop operations such as grinding valves and seats...checking guide wear and checking head warpage. The series includes *Cylinder Head Service; Engine Bottom End Construction; Engine Teardown, Cleaning, and Inspection; Engine Front End Construction; Engine Fundamentals; Engine Reassembly; Engine Top-End Construction; Short Block Service.* A Meridian Production. (25 minutes each) © 2008

Auto Shop Safety

• VHS/DVD
• Preview clip online
• Closed captioned
• Includes viewable/printable instructor's guide
• Correlates to standards
• Order #24746

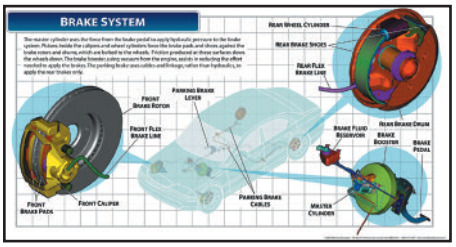
Stresses that if safety rules are not followed in an auto shop, serious injury or death can occur. Running engines, moving cars, cars on jack stands or floor jacks, open fuel lines, and other things all have the potential to cause a catastrophe. Methods for preventing accidents are shown and emphasized. A Meridian Production. (21 minutes) © 2008

Hybrid Auto Repair Series

- **VHS/DVD**
- **Preview clip online**
- **Closed captioned**
- **Includes viewable/printable instructor's guide**
- **Correlates to standards**
- **Order #35525**

A new generation of automotive technicians is emerging, made up of men and women with solid training in hybrid technology. Give your students a chance to be part of this technological revolution. This three-part series provides a thorough grounding in hybrid technologies, focusing on building both system knowledge and safety awareness. In addition to outlining the history and growth of electric, hydrogen, diesel, and other alternative propulsion systems, the series explores major hybrid components and details the safety challenges that these complex mechanisms present to technicians. Job-seekers who are looking to set themselves apart from the average automotive trainee will find the ideal learning resource in this series. The series includes *The History of Hybrids; Common Hybrid Components; Hybrid Safety Issues.* A Shopware Production. (15-18 minutes each) © 2007

Automotive Technology Posters



- **Sixteen laminated 17" x 32" posters**
- **Correlates to the National Automotive Technicians Education Foundation (NATEF) standards for automotive technology.**
- **Order #31098**

It only takes a glance to see that today's cars have more in common with the space shuttle than they do with the "horseless carriage" of a century ago. This no-nonsense 16-piece poster series will help students quickly and easily develop a familiarity with the many complicated subsystems common to domestic and foreign cars. The series includes *Ignition System Poster; Engine System Poster; Engine Cooling and Lubrication System Poster; Powertrain System-Rear Wheel Drive Poster; Powertrain System-Front Wheel Drive Poster; Exhaust System Poster; Suspension System-Conventional Poster; Suspension System-MacPherson Strut Poster; Steering System-Conventional Poster; Steering System-Rack and Pinion Poster; Brake System Poster; Safety and Restraint System Poster; Climate Control System Poster; Electrical System Poster; Electronic System Poster; Fuel System Poster.* A Shopware Product.© 2003

Drive Trains

- **VHS/DVD**
- **Preview clip online**
- **Closed captioned**
- **Correlates to standards**
- **Order #25235**

This group of six videos not only provides a general overview of drive trains and how they operate, but highlights construction, design, and components. Each video covers a specific topic and uses 3-D animation and cutaways to demonstrate working parts and how they function. Detailed areas are: • automotive clutch • flywheels • pressure plates • bands • torque converters • set-up • transmission designs • adjustments • CV axles • pistons & servos • reassembly • planetary gear sets • drive axle designs • part inspection • differential disassembly. The series includes *Automatic Transmissions; Clutch Operation and Service; CV Axles; Differential Construction and Operation; Differential Service; Manual Transmissions.* A Shopware Production. (29 minutes each) © 1992

Electrical Systems

- **VHS/DVD**
- **Preview clip online**
- **Closed captioned**
- **Correlates to standards**
- **Order #25289**

Using 3-D animation and live-action close-ups of electrical system components, these videos examine and explain elements of various systems, troubleshooting, conducting basic tests, and basic repair procedures for many system failures. Also provides detailed information about the proper tools and how to use them. Topics covered include • starting motors • solenoids • cables • ignition switches • sensors • multimeters • voltage regulators • alternators • scopes • wiring diagrams • high-voltage systems. The series includes *Charging System Operation; Charging System Service; Ignition System Operation; Ignition System Service; Starting System Operation; Starting System Service; Using a Load Tester.* A Meridian Production. (25 minutes each) © 1991

Cooling Systems

- **VHS/DVD**
- **Closed captioned**
- **Order # BVL25122**

This video provides a comprehensive explanation of the theory and design of cooling systems, including operation and function of all major components. Includes information on • water jackets • thermostat • water pump • radiator • hoses • clamps • coolant circulation • operating temperatures • typical repairs • flushing a cooling system. A Meridian Production. (27 minutes) © 1991

P. O. Box 2053, Princeton, NJ 08543-2053

www.films.com

Call Toll Free: 800-487-3392

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