



AUTO BODY REPAIR

## PLASTICS AND ADHESIVES



TEACHER'S GUIDE

SHOPWARE®

## INTRODUCTION

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This Teacher's Guide provides information to help you get the most out of *Plastics and Adhesives*. The contents in this guide will enable you to prepare your students before using the program and present follow-up activities to reinforce the program's key learning points.

As part of the 12-part series *Auto Body Repair*, this *Plastics and Adhesives* video shows how to safely prepare, fix, and refinish holes in fiberglass and plastics with thermoplastic and thermoset plastic. Repairing plastic parts with urethane and epoxy adhesives is also illustrated. After viewing this video and completing some of the learning activities included in this guide, students will be better prepared to properly work with plastics and adhesives, and incorporate industry terminology in order to communicate effectively with coworkers, parts suppliers, and insurance adjusters. Use the *Plastics and Adhesives* video and accompanying activities provided in this guide to prepare students for the most effective way to approach auto body repairs, and to familiarize them with terminology used in the auto repair industry.

## LEARNING OBJECTIVES

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After viewing the program, students will be able to:

- Demonstrate a basic knowledge of plastic and adhesive repair operations and safety procedures.
- Identify the correct tools to use given the task to be performed.
- Identify, remove, repair, and/or replace automotive plastic components.
- Perform fiberglass and plastic repairs.

## EDUCATIONAL STANDARDS

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The primary certifying body for automotive technician training programs is the National Institute for Automotive Service Excellence (ASE). ASE is a non-profit organization established in 1972 by the automotive industry to improve the quality of vehicle repair and service through the voluntary testing and certification of automotive repair technicians. The National Automotive Technicians Education Foundation (NATEF) is a separate non-profit foundation within ASE. The mission of NATEF is to improve the quality of automotive technician training programs nationwide through voluntary certification. The State Departments of Education in all 50 states support ASE/NATEF certification of automotive programs.



## **National Standards**

This program correlates with the Program Certification Standards for Automobile Technician Training Programs from the National Institute for Automotive Service Excellence (ASE) and the National Automotive Technicians Education Foundation (NATEF). The content has been aligned with the following educational standards, which reflect the tasks in the ASE Program Certification Standards for Automobile General Service Technician Programs.

### **Preparation**

- 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.

### **Plastics and Adhesives**

- Identify the types of plastics; determine repairability.
- Identify the types of plastics repair procedures; clean and prepare the surface of plastic parts.
- Repair plastic parts with urethane or epoxy adhesives; use reinforcements if necessary.
- Repair holes and cuts in rigid and flexible plastic parts using backing materials and adhesives.
- Retexture plastic parts.
- Prepare repaired areas for refinishing.

### **General Operations**

- Identify parts using industry terminology.

*2004 Automobile Program Standards, by the National Institute for Automotive Service Excellence (ASE), Copyright 2004 Reprinted with permission.*

### **Language Arts and Communication Standards**

According to ASE/NATEF standards, the automobile technician must be proficient in the following Language Arts and Communications related academic skills that are embedded in the occupation. The activities and information presented in this program and accompanying teacher's guide are aligned to the following standards from the National Automotive Technicians Education Foundation from the National Institute for Automotive Service Excellence.

- 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.
- 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.
- 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.
- Follow all oral/written directions that relate to the task or system under study.
- Comprehend and apply industry definitions and specifications to diagnose and solve problems in all automotive systems and components of the automobile and light truck.
- Comprehend and use problem-solving techniques and decision trees that are contained in service manuals and databases to determine cause-and-effect relationships.
- Use the service manual to identify the manufacturer's specifications for system parameters, operation, and potential malfunctions.
- Supply clarifying information to customers, associates, parts supplier, and supervisors.

### Technology Standards

The activities in this Teacher's 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.

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

## PROGRAM OVERVIEW

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Today's cars include many plastic parts, such as bumpers, covers, fenders, instrument panels, trim, engine parts, and more. So what should you do when you find a car with a damaged plastic part? When should you repair a plastic part instead of just replacing it? Working with plastics and adhesives is tricky—and can be dangerous, too. This video shows how to safely prepare, fix, and refinish holes in fiberglass and plastics with thermoplastic and thermoset plastic. It also illustrates how to repair plastic parts with urethane



and epoxy adhesives. After viewing this video and completing some of the learning activities included in this guide, students will be better prepared to properly work with plastics and adhesives, and incorporate industry terminology in order to communicate effectively with coworkers, parts suppliers, and insurance adjusters.

## **MAIN TOPICS**

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### **Topic 1: Assessing Whether to Repair or Replace a Plastic Part**

This section of the program describes general guidelines for determining whether to replace a plastic part entirely, or repair it. Students will learn to base repair or replace decisions on an assessment of repair time versus the cost for a new part, and explore situations where repair may be the best option, as well as situations where replacement may be the best option.

### **Topic 2: Safety Guidelines for Plastics Repair**

This section of the program describes safety precautions and procedures for working with plastics and adhesives. Students will learn the proper protective clothing and gear to wear when working with these substances, as well as other important safety considerations.

### **Topic 3: Preparing for Repair**

This section describes the procedures for preparing a plastic part for repair. Students will learn the different types of plastic for repair, and the types of adhesives that should be used with each type of plastic. Students will also learn how to correctly clean and prepare the part for application of adhesive filler.

### **Topic 4: Applying Adhesive Filler**

This section discusses the correct ways to apply adhesive filler to a plastic part. Students will learn how to dispense, mix, apply, and cure adhesive in order to repair a plastic part.

### **Topic 5: Reinforcing Damaged Areas**

The section of the program describes the process for reinforcing damaged areas when making repairs to plastic parts. Students will learn how to correctly apply reinforcement netting and adhesive to properly reinforce repairs.

### **Topic 6: Replacing Plastic Parts**

This section describes the procedures for replacing plastic parts. Students will learn the difference between primed and raw plastic parts, and how each should be prepared before replacement and painting. This section also discusses special procedures that must be followed for flexible plastic.



## FAST FACTS

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- Today, plastic car parts include bumper covers, fender extensions, fascias, fender aprons, grille openings, stone shields, instrument panels, trim, trim panels, fuel lines, and even engine parts. If damaged, most of these parts would not be repaired, they would be replaced.
- A decision to repair or replace a plastic part is based on an assessment of repair time versus the cost of a new part.
- The most common method for repairing a plastic part is to use a two-part, epoxy-type repair adhesive. Two-part adhesive consists of a base resin and a hardener. Most two-part adhesives come in dispensers that contain both the hardener and resin. When extruded and properly mixed, the adhesive cures into a material similar to the piece being repaired.
- Plastics can be either rigid or flexible. If the part bends, it's considered flexible plastic. If it does not bend, it is considered rigid. There are also two kinds of adhesives—those used with flexible plastic parts, and those used with rigid plastics.
- When preparing a plastic part for repair, avoid a lot of rubbing during the cleaning process. With plastics, the more you rub, the more static electricity is created. Static electricity attracts dust and dirt, which will show up in the final finish.
- Never use lacquer-based products or gasoline for cleaning plastics. They are not compatible with finishing products.
- Cleaning steps are important to the success of the plastics repair process. If you don't clean the part properly, the adhesive repair or the final paint job may fail.
- Adhesion promoters promote adhesion of the adhesive filler and paint to the plastic. They do this by actually softening the plastic. Then, when adhesives and paint are applied, they bond chemically to the plastic, eliminating later cracking, chipping and peeling. Remember to use a second coat of adhesion promoter before applying a second coat of adhesive filler.
- Most adhesive fillers come in dispensers that automatically extrude the adhesive and hardener in the correct proportions.
- It's important to use clean tools when mixing together adhesive and hardener. Dirty spreaders and palettes will contaminate your mixture and keep you from getting a smooth finish when you apply the adhesive.
- Sometimes in plastics repairs, it's necessary to reinforce the damaged area, especially if there are deep gouges or holes. Typically a piece of plastic netting, with a peel-away plastic backing, is used for reinforcement.
- Replacement plastic parts fall into two categories: primed and raw. Primed parts must first be sanded, then washed with soap and water and a water-based degreaser. Raw plastic parts must first be washed with soap and water, then degreased. They then need to be sprayed with an adhesion promoter to insure that the paint will adhere properly.
- After painting a plastic part with color coats of paint, you will need to apply two or more clear coats. Because you are painting plastic, and plastic is flexible (even the rigid kind), you will need to add a special ingredient to the clear coat to make it flexible as well. Otherwise, the clear coat will harden, then chip or flake off when the plastic flexes.



## VOCABULARY TERMS

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**adhesion promoter:** A substance that promotes the adhesion of the adhesive filler and paint to the plastic by actually softening the plastic and causing adhesives and paint to bond chemically to the plastic.

**cure:** To prepare, preserve, or finish (a substance) by a chemical or physical process. Cure time for plastics varies depending on the product used, the temperature, and the relative humidity. The ideal curing temperature is 70° Fahrenheit.

**fascia:** The part of an automobile body that is in front of the fenders. The fascia is also known as the nose of the car's body.

**feather:** The technique of blending the repair of a damaged area into the undamaged area, maintaining the original surface texture and sheen.

**flexible plastic:** Plastic that bends.

**grille:** Grating that allows air to reach a car's radiator, for the purpose of cooling. This is found on the front of an automobile.

**grind:** To use an abrasive wheel to shape or remove extra plastic.

**hardener:** A chemical component of an epoxy resin that starts a catalytic reaction and causes the mixture to harden.

**resin:** The molten plastic part of fiberglass-reinforced plastic.

**rigid plastics:** Plastic that does not bend.

**surfacer:** A substance that fills in fine lines created during sanding.

**two-part epoxy-type adhesive:** A substance consisting of a base resin and a hardener, used for bonding plastics together. Most two-part adhesives come in dispensers that contain both the hardener and resin. When extruded and properly mixed, the adhesive cures into a material similar to the piece being repaired.

## PRE-PROGRAM DISCUSSION QUESTIONS

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1. List at least ten parts on a car vehicle that might be made of plastic. Where are each of these parts located?
2. When do you think it would be better/easier to just replace a plastic part on a car instead of trying to repair it? Conversely, when would it be better/easier to repair a plastic part instead of replacing it?
3. What tools and substances do you think are used by auto body repair technicians when repairing, replacing, and painting plastic parts?
4. What safety precautions do you think would be important when repairing plastic parts?
5. What do you think would be some of the biggest challenges you would face when performing repairs to plastic parts? Why?



## POST-PROGRAM DISCUSSION QUESTIONS

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1. The first step for preparing any plastic part for repair is cleaning the part. Why is this step so important? Why is it so important to avoid a lot of rubbing during the cleaning process? What could be the consequences if a plastic part is not properly cleaned before being repaired?
2. When might it be necessary to reinforce a damaged area when performing repairs to plastic parts? What are the tools, substances, and correct process that would be used to reinforce a plastic part?
3. What is the difference between a primed part and a raw part? How must each be handled and prepared for replacement?
4. Name at least five important safety procedures and/or pieces of protective gear that should be used when repairing plastic parts. Why are each of these important? What injuries can they prevent?
5. Describe the process for preparing a repaired or replacement part for painting. Once the part is prepared, what are the steps for painting that part? What special measures are called for when painting flexible plastic parts? Why?

## GROUP ACTIVITIES

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### Plastics Repair: My Shop is the Best! Advertisement

You are the proud owners of an autobody shop that specializes in repairs involving plastics and adhesives. As a group, prepare a written script for a television advertisement that tells customers why your autobody shop is the best shop to come to for repairs to plastic parts. What are some things that consumers should know about your shop that makes it unique among other shops? What procedures does your shop use to make sure all repairs have a flawless result? When you are finished, present/act out your television advertisement for the rest of the class.

### Plastic Concept Car

Automotive designers continue to seek to reduce the weight of cars in order to improve fuel efficiency, while focusing on safety, sleek looks, and durability. Using plastics in new ways helps these designers achieve this. As a group, research new and innovative ways plastic is being used in cars. Design a “concept car” using plastic in as many innovative ways as possible. You can draw your car, or create a model of it using clay, plastic pieces, or other household items. Be prepared to explain which parts of the car are made of plastic, why you decided those parts should be made of plastic, and how using plastic for those parts will make the car better. Consider items such as costs, repair times, pollution, and more.





## **Repair or Replace?**

As a group, put together a list of at least five different plastic parts on a car, and take pictures or find examples of those parts (if available). For each part, discuss the following: Would it be better to repair the part or just replace it? Why? If you were to repair the part, what things would you need to take into consideration (e.g., paint, sanding, reinforcement, cleaning, surfacing, etc.). Be prepared to present your parts and discussion to the class.

During each group's presentation, write down your thoughts about the following:

- Did you disagree with any decisions by other groups to repair or replace a certain plastic part? Why?
- What would you do differently than presented?

At the end of each group's presentation, discuss your opinions with the rest of the class.

## **INDIVIDUAL STUDENT PROJECTS**

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### **How-To Plastic Repair Guide**

Prepare a brochure, booklet, or poster that illustrates the step-by-step procedure for making repairs to a plastic part. You can choose any plastic part you wish to illustrate how the repairs should be completed. Be sure to illustrate each step with either pictures you find in magazines, books, or on the Internet, or, if you prefer, you can create your own pictures.

### **Plastics and Adhesives Safety Poster Campaign**

It is important to be VERY careful when working with plastics and adhesives, as improper use and not taking the proper safety precautions can result in fires or physical injuries. Prepare a series of three safety posters teaching some of the safety precautions you should take when working with plastics and adhesives. Be sure to explain what the precaution is, why it is so important, and what could happen if you are not careful. These posters may be displayed in the classroom for other students to see.

### **History of Plastic Timeline**

The use of plastic has come a long way since its invention in 1860. Prepare a poster or chart with a timeline that shows the history of plastic and how it has evolved to become part of everyday life. Be sure to include dates and descriptions of how/when it was first used in cars and new dates/descriptions of how it became used more frequently in cars over time.

## **INTERNET ACTIVITIES**

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### **Teach Me! Web Scavenger Hunt**

It's your turn to play the role of teacher! Your job is to teach the class all about plastics and adhesives using only information you find on the Internet. Prepare a lesson plan that uses a



series of Web sites that you could use to teach the topic. Your lesson plan should include at least three unique lessons about plastics and adhesives. For each lesson, list the Web site, what information it contains, and how you would use that information to teach the class about plastics and adhesives. When you are finished, present at least one of your lessons to the class.

### **Innovations in Plastic**

Visit [http://www.plastics-car.com/s\\_plasticscar](http://www.plastics-car.com/s_plasticscar) to learn about new innovations in the use of plastics in cars. Using this Web site, choose at least three new innovations for using plastics in cars, and create a poster or booklet describing each of these innovations. For each innovation, be sure to describe:

- what it is
- how it is different from what's been done in the past
- what types of new benefits it offers, including cost, environmental, and usage
- examples of how it is currently being used

### **Stick It: Adhesives Everywhere!**

Using a search engine, research the different types of adhesives that exist for repairing different automobile parts, including plastic parts. Create a chart comparing the different types of adhesives. Be sure to include the name of each adhesive, what types of repairs it is commonly used for, why it is used for that type of repair (i.e., what about the adhesive makes it best for a specific type of repair), who manufactures it, and other details. Be prepared to share your findings with the class.

## **ASSESSMENT QUESTIONS**

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**Q:** If resin or hardener comes in contact with your skin, what should you do?

- (a) Put a protective skin cream on the area that it touched.
- (b) Rinse it with water
- (c) Wash the areas with borax soap and water or alcohol
- (d) Don't worry about it, it is harmless.

**A:** (c)

**Feedback:** If resin or hardener comes in contact with your skin, wash with borax soap and water or alcohol.

**Q:** What does a two-part adhesive consist of?

- (a) Resin and adhesion promoter
- (b) Flexible and rigid adhesive
- (c) Base resin and hardener
- (d) None of the above

**A:** (c)

**Feedback:** Two-part adhesive consists of a base resin and a hardener. Most two-part adhesives come in dispensers that contain both the hardener and resin. When extruded and properly mixed, the adhesive cures into a material similar to the piece being repaired.



**Q:** When cleaning a plastic part in preparation for repair, be sure to rub the piece a lot to get rid of any dirt or grease. (True or False)

**A:** False

**Feedback:** Avoid a lot of rubbing during the cleaning process. With plastics, the more you rub, the more static electricity is created. Static electricity attracts dust and dirt that will show up in the final finish.

**Q:** What does adhesion promoter do?

**A:** Adhesion promoter improves the adhesion of adhesive filler and paint to plastic by softening the plastic.

**Feedback:** Just as it says, adhesion promoter promotes adhesion of the adhesive filler and paint to the plastic. It does this by actually softening the plastic. Then when adhesives and paint are applied, they actually bond chemically to the plastic, eliminating later cracking, chipping, and peeling.

**Q:** What is the ideal curing temperature for adhesives?

- (a) 70 degrees
- (b) 75 degrees
- (c) 80 degrees
- (d) 65 degrees

**A:** (a)

**Feedback:** The ideal curing temperature for adhesives is 70° Fahrenheit.

**Q:** After sanding and before painting, what should you apply to a plastic part?

- (a) Adhesion promoter
- (b) Clear coat
- (c) Reinforcement
- (d) Surfacer

**A:** (d)

**Feedback:** Apply a coat of surfacer to plastic parts before painting. The surfacer fills in all the fine lines you created during sanding.

**Q:** Once the surfacer has dried, finish by hand sanding with \_\_\_\_\_, depending on the topcoat to be applied.

- (a) 80-grit or 120 grit
- (b) 400-grit dry or 600-grit wet
- (c) 180 grit or 240 grit
- (d) none of the above

**A:** (b)

**Feedback:** Once the surfacer has dried, finish by hand sanding with 400-grit dry or 600-grit wet, depending on the topcoat to be applied.

**Q:** When a part requires reinforcement, you typically use a piece of \_\_\_\_\_.

**A:** plastic netting

**Feedback:** Typically, when a part requires reinforcement, technicians use a piece of plastic netting with a peel-away plastic backing.



**Q:** Before painting, what do you need to do differently when replacing a primed versus a raw plastic part?

**A:** Primed parts must first be sanded, and then washed with soap and water and a water-based degreaser. Raw plastic parts must first be washed with soap and water, then degreased, and then sprayed with an adhesion promoter.

**Feedback:** Raw plastic parts do not require sanding.

**Q:** When painting a plastic part, you will need to add a special ingredient to the clear coats, even if the plastic is the rigid kind. (True or False)

**A:** True

**Feedback:** After the color coats dry, you'll need to apply two or more clear coats. Because you're painting plastic, and plastic is flexible (even the rigid kind), you will need to add a special ingredient to the clear coat to make it flexible as well. Otherwise, the clear coat will harden, then chip or flake off when the plastic flexes.

## **ADDITIONAL RESOURCES**

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### **WEB SITES**

**Auto Body Online**

[www.autobodyonline.com](http://www.autobodyonline.com)

**Auto Body PI**

[www.autopi.com/frame.htm](http://www.autopi.com/frame.htm)

**Auto Body Pro**

[www.autobodypro.com](http://www.autobodypro.com)

**Automotive Body Repair News**

[www.abrn.com/abrn](http://www.abrn.com/abrn)

**Auto Glossary**

[www.autoglossary.com](http://www.autoglossary.com)

**Automotive Plastics Council**

[www.plastics-car.com](http://www.plastics-car.com)

**Automotive Services Association**

[www.asashop.org](http://www.asashop.org)

**Automotive Youth Educational Systems (AYES)**

[www.eyes.org](http://www.eyes.org)

**Collision Repair Industry Insight**

[www.collision-insight.com](http://www.collision-insight.com)



## **How Stuff Works—Auto Stuff Page**

<http://auto.howstuffworks.com>

## **I-car**

[www.i-car.com](http://www.i-car.com)

## **National Automotive Service Task Force**

[www.nastf.org](http://www.nastf.org)

## **National Automotive Technicians Education Foundation**

[www.natef.org](http://www.natef.org)

## **Society of Collision Repair Specialists**

[www.scrs.com](http://www.scrs.com)

## **Tektips—Auto Body Pro Website**

[www.autobodypro.com/tektips.htm](http://www.autobodypro.com/tektips.htm)

## **BOOKS**

Duffy, James E. *I-CAR Professional Automotive Collision Repair*. Albany, NY: Delmar Thomson Learning, 2001. ISBN: 0766813991

Duffy, James E. *Auto Body Repair Technology, 4th Edition*. Clifton Park, NY: Thomson/Delmar Learning, 2003. ISBN: 0766862747

Killingsworth, Jeff, Eric Godfrey, and John H. Haynes. *The Haynes Suspension, Steering And Driveline Manual*. Newbury Park, CA: Hayes North America, 1998. ISBN: 1563922932

Scharff, Robert, and James E. Duffy. *Motor Auto Body Repair, 3rd Edition*. Albany, N.Y.: Delmar Publishers, 1998. ISBN: 0827368585

## **OTHER PRODUCTS**

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**Auto Body Shop Safety**, Software, Cambridge Educational, A Shopware Production. Safety procedures relevant to the auto body shop are outlined, along with lessons on First Aid, Fire Safety and Prevention, Wire Feed MIG Welding, and Proper Use of Auto Body Tools. 3.5" IBM version, Mac version also available.

Order #: 20941, [www.cambridgeeducational.com](http://www.cambridgeeducational.com), 1-800-468-4227

**Multimedia Auto Shop Safety**, Software, Cambridge Educational, A Shopware Production. This multimedia CD-ROM uses video, animation and still photos to examine the topics of general shop safety, fire safety and prevention, first aid, and safe tool use for mechanics. The segment dealing with overall shop safety emphasizes the link between cleanliness and organization, as well as personal safety considerations of glasses, earplugs, shoes, and clothes.



The first aid portion suggests that a certified first aid class be taken, but it offers an excellent survey of first aid practices, including what NOT to do. Correct fire extinguisher usage is illustrated by memorable graphics. The auto workshop is portrayed as a work site of numerous potential hazards, while at the same time the viewer is taught how to cope with the challenges of volatile auto products, damaged electrical cords, and welding cylinders and their contents. The mechanic's tools are shown to be a statement of their owner's professionalism. It seeks to foster that professionalism by describing the safe care and use of hand and power tools, wrenches, auto body tools, and measuring devices. Part of the series *Shop Safety*. (Windows/Macintosh)

Order #: 20463, [www.cambridgeeducational.com](http://www.cambridgeeducational.com), 1-800-468-4227

### **Automotive Technicians**, VHS/DVD, Cambridge Educational

Sponsored by the National Automotive Technicians Education Foundation (NATEF), this program explores automobile repair and collision repair. NATEF works closely with Automotive Service Excellence (ASE), the nation's only industry-wide certification program for automotive technicians. Technicians with a sound education have a choice of career avenues. Aside from fixing cars and trucks, they can become service managers, service engineers, automotive writers, or even auto technology teachers.

Order #: 24924, [www.cambridgeeducational.com](http://www.cambridgeeducational.com), 1-800-468-4227

### **Understanding Cars**, VHS/DVD, Films for the Humanities and Sciences

First they revolutionized travel. Then they reshaped American culture. This program, narrated by Jane Curtin, traces the history of automobile technology and design through the 20th century. Stops along the way include visits to the Sandia National Laboratories, the GM Design Center, the Detroit Car Show, and the Petersen and Blackhawk Automotive Museums. The mechanics of four-stroke and two-stroke internal combustion engines, energy-efficient vehicles that run on electricity and fuel cells, automated highways and smart cars, and a number of automotive curiosities are featured.

Order #: 29881, [www.films.com](http://www.films.com), 1-800-257-5126





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