



AUTO BODY REPAIR

## AUTO CONSTRUCTION



TEACHER'S GUIDE

SHOPWARE®

## INTRODUCTION

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This Teacher's Guide provides information to help you get the most out of *Auto Construction*. 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*, *Auto Construction* describes the various parts and sections of a vehicle, and the way in which auto design impacts the diagnosis and repair of damaged vehicles. After viewing this video and completing some of the learning activities included in this guide, students will be better prepared to properly diagnose and repair damaged vehicles, and incorporate industry terminology in order to communicate effectively with coworkers, parts suppliers, and insurance adjusters. Use the *Auto Construction* video and accompanying activities provided in this guide to prepare students for the most effective way to approach auto body repairs, and to familiarize students with terminology used in the auto repair industry.

## LEARNING OBJECTIVES

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After viewing the program, students will be able to:

- Identify the components of the automobile body and frame.
- List common types of assemblies, suspensions, and frame constructions.
- Explain why, to ensure proper auto body repair, it is important to understand how an automobile is constructed.

## 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.



## Vehicle Construction

- Identify type of vehicle construction (space frame, unibody, body over frame).
- Recognize the different damage characteristics of space frame, unibody, and body over frame vehicles.
- Identify impact energy absorbing components and repair/replacement procedures.
- Identify steel components and repair/replacement procedures.
- Identify aluminum/magnesium components and repair/replacement procedures.
- Identify plastic/composite components and repair/replacement procedures.

## General Operations

- Identify parts 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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Are some vehicles easier to repair than others? How does vehicle design and construction impact the work of auto body repair technicians? What challenges do auto body repair technicians face when repairing certain types of vehicles? These are some of the questions answered in this compelling video. The program describes the various parts and sections of a vehicle, including the characteristics of vehicle parts and their relationship to one another, and the way in which auto design impacts the diagnosis and repair of damaged vehicles. Viewers will have the opportunity to closely examine the design and construction of various frames and the three auto body sections, including the major parts, panels, and assemblies housed in each one. After viewing this program, viewers will be better prepared to properly diagnose and repair damaged vehicles, and able to incorporate industry terminology in order to communicate effectively with coworkers, parts suppliers, and insurance adjusters.

## MAIN TOPICS

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### Topic 1: Basic Auto Frame Styles

This section describes the three basic frame styles used in the construction of small trucks and automobiles on the road today. Students will learn the characteristics of each frame type, including variations among frame designs, and the advantages and challenges auto repair technicians face when repairing or replacing each type.

### Topic 2: Auto Body Sections

This section of the program describes the three body sections of a vehicle that auto body professionals often refer to when discussing collision repairs. Students will closely examine the major parts, panels, and assemblies housed in each section, and learn how their construction impacts repair and replacement.



## FAST FACTS

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- The frame of a vehicle is its foundation, similar to the foundation of a house. All other parts and assemblies are attached directly or indirectly to the frame.
- The three basic frame styles used in the construction of today's small trucks and automobiles are body-over-frame (or BOF), unibody, and space frame.
- The body-over-frame design utilizes strong steel that is about 1/8-inch thick, which is formed in U- or box-shaped sections to which body parts are bolted. This type of frame is characterized by two steel rails that run the length of the vehicle and welded-on cross-members that attach the frame rails to each other. Variations of the BOF design include the perimeter frame, X-frame, combination frame, and ladder frame.
- Due to the BOF's simplified structure repairs are easily checked for accuracy and are easily made, as opposed to repairs on other frame designs, because most body parts are bolted rather than welded or bonded to the frame.
- Most of today's vehicle frames are built in one piece, called a unibody, which is constructed by welding, bolting and adhesive-bonding the various body parts together, creating a strong, structural "shell." Unibody frames protect passengers during a collision by absorbing most of the impact, but the frame can sustain damages that can be overlooked during initial inspection.
- Repair of unibody vehicles is challenging because both the roof and quarter panels are often welded or bonded into place by adhesive for structural strength. Removing and replacing a damaged roof or quarter panel can be more time-consuming than in a BOF vehicle.
- A space frame is a lightweight aluminum frame consisting of a strong steel cage that is covered with plastic or composite panels, which typically clip on or are adhesive-bonded to the frame.
- Repair of space frames is easier than unibody frames, since the panels on a space frame can be removed without affecting the structural strength of the vehicle; but like unibody frames, space frames are more likely to have hidden damage.
- When discussing collision repairs, auto body professionals often refer to three body sections: the front section, the center or midsection, and the rear or tail section.
- The front section, or front-end assembly, includes everything from the bumper to the cowl—the part of the body just in front of the windshield.
- The center, or midsection, includes the floor pan, pillars, rocker panels (doorsills), rear bulkhead, roof, dash assembly, and doors.
- The rear or tail section includes the trunk floor panel, inner wheel housing, rear and lower quarter panels, and the trunk lid.
- Needed parts are often called out by right side and left side. In American vehicles, the right side is the passenger side and the left side is the driver's side, where the steering wheel is located.



## VOCABULARY TERMS

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**battery tray:** A flat structure that supports the vehicle's battery.

**body bracket:** The area of a frame that provides places to attach body components.

**body-over-frame (BOF):** A heavy frame type that is characterized by two 1/8-inch steel frame rails that run the length of the vehicle, and welded-on crossmembers that attach the frame rails to each other. Body parts are bolted rather than welded or bonded to the frame.

**bumper assembly:** An assembly that consists of a plastic bumper cover and an inner steel or aluminum bumper and grille, which bolts to the front frame horns in a conventional frame or to the frame rails that extend out near the bottom of the front section of a unibody frame. Some vehicles have a plastic honeycomb or foam structure that is designed to compress and absorb the energy of a front-end collision.

**combination frame:** A frame consisting of a perimeter frame and an X-frame that is one of the heaviest and strongest frames made.

**control arm suspension (independent suspension):** A front suspension that is attached to the frame, consisting of upper and lower control arms that are of different lengths, ball joints, coil springs, and shock absorbers, which is designed to reduce tire scuffing.

**cowl assembly:** The part of a car's body located directly in front of the windshield, which includes the top cowl panel and side cowl panels that extend down on either side of the body.

**crossmember:** A part of the underbody structure of a vehicle that extends from one side of the frame to the other or from one side of the unibody to the other.

**dash (front bulkhead or firewall):** The area of a vehicle that divides the vehicle's front section from its midsection or passenger compartment, which is usually welded into place.

**dash assembly (instrument panel):** The panel that holds the padded dash, instrument assembly, and the AC, heat, and sound system controls.

**door assembly:** Structure that consists of an outer skin, an inner stamped metal frame that includes an intrusion beam, door handles and locks, door latches and striker plates, window glass, and a window regulator that raises or lowers the glass with the push of a button or the turn of a crank.

**floor pan:** The main structural panel, usually comprised of one piece of stamped steel, in the center or midsection of a vehicle that forms the floor of the interior of the vehicle.

**frame:** The structural foundation of a vehicle to which all other parts and assemblies are attached directly or indirectly.

**frame horns:** The front ends of side rails on a body-over-frame where the bumper attaches.

**front fender:** A component that extends from the front bumper to the front doors, and covers the front suspension and the inner fender aprons.

**front section/front-end assembly:** The section of a vehicle that includes everything from the bumper to the cowl—the part of the body just in front of the windshield.

**hood:** The hinged panel that covers the engine compartment.

**hood hinge:** Components that attach the hood to the cowl.

**inner fender skirt/front fender apron:** Panels that are often attached to the front rails and cowl assembly and surround the front wheels to keep road debris out of the engine compartment.

**inner wheel housing:** Panels that surround the rear wheels and deflect road debris.

**ladder frame:** A conventional (BOF) frame design that consists of two side rails, not necessarily parallel, connected to each other by a series of cross members like a ladder.



**lower rear panel:** The panel that extends from one quarter panel to the other and forms the bottom side of the trunk.

**partial frame:** A cross between a conventional frame (BOF) and a unibody: the center section consists of unibody construction, while the front and rear are composed of sub-frame assemblies.

**perimeter frame:** A common type of conventional (BOF) frame found on pick-up trucks and vans consisting of side rails that extend the full length of the vehicle and surround the passenger compartment.

**pillars:** The vertical supports for the roof that protect passengers during roll-over, or from an impact on the roof of the vehicle.

**radiator core support:** The structural framework that is usually fastened to the inner fender aprons and the frame rails and which holds the radiator and related cooling system parts in place.

**rear bulkhead:** Panel that separates the passenger compartment from the trunk and rear section of the vehicle.

**rocker panels/doorsills:** The high-strength beams at the bottom of the door openings that are normally welded to the floor pan, pillars, and quarter panels.

**roof:** The large panel that is welded to the pillars for strength.

**side intrusion beam:** A structural element within a door that protects passengers from side impacts.

**sub-frame assembly:** Partial frames and body components that together support the suspension system and drivetrain.

**McPherson strut system:** A shock-absorbing front suspension system typically used in unibody vehicles consisting of a coil spring, upper suspension locator, and shock absorber that is mounted vertically between the top arm of the steering knuckle and the strut tower on the front fender apron.

**rear assembly:** The stamped metal panel that is often welded to the rear rails, inner wheel houses, and lower rear panel, which includes the trunk floor panel that forms the bottom of the trunk and often provides a “well” for storing the spare tire.

**quarter panels:** The large side panels in a unibody vehicle extending from the rear doors to the rear bumper, which are attached to the inner wheel houses, rear pillars, trunk floor panel, and rear crossmember.

**rocker panels (doorsills):** High-strength beams at the bottom of the door openings that are normally welded to the floor pan, pillars, and quarter panels.

**shell:** The strong structure of a unibody vehicle formed by welding, bolting, and adhesive bonding the various body parts together.

**shock or strut tower:** The part of the front fender apron that holds the upper parts of a strut suspension system in place.

**space frame:** Type of lightweight aluminum frame consisting of a high-strength steel cage that is covered with plastic or composite panels, which typically clip on or are adhesive-bonded to the frame.

**torque boxes:** Components that allow the frame to absorb twisting motion as the vehicle encounters bumps in the road.

**trunk lid or hatch:** A hinged panel covering the rear storage area that includes hinges, a lock, latch, and striker plate.



**unibody:** A term used to describe vehicles in which the frame rails and body panels are connected as one unit, which provide the structural strength to the vehicle. This frame type is most often found in present-day vehicles.

**x-frame:** A type of conventional (BOF) frame design that is typically found on older cars, convertibles, and large American cars, consisting of two long rails that cross over in the middle of the center section forming a thick beam or center backbone.

## **PRE-PROGRAM DISCUSSION QUESTIONS**

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1. Do you know the type of frame your vehicle or family vehicle has? If so, what type of frame is it? If not, how might you find out what type of frame it is?
2. How might auto construction and design influence the repair of vehicles?
3. If given the opportunity to win a free vehicle of your choice, what type of auto would you choose based on your current knowledge of auto design, and why?
4. If given the opportunity to design your own automobile, what changes would you make to current styles without compromising safety or performance?
5. Today the X-frame can be found in delivery trucks, but is no longer used in the construction of passenger autos. Considering the design of this frame, why do you think this is?

## **POST-PROGRAM DISCUSSION QUESTIONS**

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1. Now that you have seen the *Auto Construction* video, what type of frame would you most prefer to repair or replace, and why? What type of frame would you least prefer to repair or replace, and why?
2. As a group, list the three types of frame designs and the advantages and challenges each one poses to auto body repair professionals.
3. What are the three body sections of a vehicle that auto body repair technicians often refer to when discussing collision repairs? What types of components or parts are housed in each section?
4. Why is it important to have an understanding of automobile construction in relation to proper auto body repair?
5. In your opinion, what do you think is the most challenging aspect of auto body repair?

## **GROUP ACTIVITIES**

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### **Become a Songwriter**

Your group has been hired to create a jingle or song for an auto body repair establishment for advertising purposes. They have asked that you begin with a popular pop, rock, or rap song and rewrite the words to advertise their area of expertise. As a group, decide which type of frame the auto body repair establishment specializes in, but do not include the name of the auto frame design. For example, if the auto body repair shop specializes in unibody styles, do not include that information. Draft a song that incorporates the characteristics of the frame style that you learned about in the *Auto Construction* video. Before presenting your





song, inform the audience that they should be prepared to identify the type of frame you are singing about. Present the song to the class, using sound effects, if desired. Then, invite the class to identify the frame style in your jingle or song.

### **Frame Repair Talk Show**

Your group is appearing on a talk show to discuss repairing a unibody frame, the most common frame design found in vehicles today. As a group, research the answers to the questions listed below.

- What are the steps in the unibody repair process?
- What are the major parts, panels, and assemblies housed in the body sections?
- What are some of the specific steps in the repair process that might require the skills of a trained technician?
- What are some of the tools that are used during the repair process?

Use the following URL to begin your search:

[http://www.natef.org/program\\_standards/collision/task\\_list\\_3.cfm](http://www.natef.org/program_standards/collision/task_list_3.cfm)

As a group, present your findings to the class in the form of a talk show. Appoint one student as the host, and the others as guest speakers. Prepare a script in interview format using the questions above. Involve the “audience” at the end of the presentation in a question and answer format. *Optional:* Prepare a handout(s) of your findings to distribute to the audience.

### **Approaching Auto Body Repair—Questions to Ask**

As a group, prepare a list of critical factors that auto body repair technicians should initially consider when approaching auto body repairs for the three basic frame styles. Consult the *Auto Construction* video, the Internet, and any other sources that you have available. Jot down a list of questions that need to be answered, or individuals you should consult, before a repair technician would begin the task of repairing a damaged vehicle. You do not have to provide answers to the questions, only the questions about what should be considered for the particular frame design, such as “Does this frame type often conceal hidden damage?” Divide the list into body-over-frame (BOF), unibody, and space frame. Then, prepare a brochure for each frame style that lists concerns that should be considered that will enable apprentice auto body repair technicians to better understand the potential advantages and challenges of repairing each frame type. Be prepared to share your brochures with the class.

## **INDIVIDUAL STUDENT PROJECTS**

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### **Factory Publications Research (*Prerequisite required*)**

In the beginning of this program your instructor asked, “If given the opportunity to win a free vehicle of your choice, what type of auto would you choose based on your current knowledge of auto design, and why?” Do you remember the vehicle you selected? Most, if not all, auto manufacturers publish factory publications for cars, pickup trucks, vans, and SUVs. Contact (by phone, personal visit, letter, etc.) an auto factory and request factory service information for your *dream machine*. (Some guides may be found online at car manufacturers’ web sites.) Factory publications provide specifications, detailed procedures, and other information specific to the year, make, and model of the vehicle being repaired. This information is



often needed to do professional, quality work. Prepare a one-page summary of informative and procedural information about repairing your dream machine, using the information you obtain from the factory publication. You may also want to consult <http://www.carcentral.net/content/pictures.php> to acquire a picture of your dream car to include in the written summary.

### **Field Research—A Day in the Life**

What is a typical day like for an auto body repair technician? One way to learn about the profession is to visit a local auto body repair shop and speak with an experienced auto body repair professional. Contact (call or visit) a local auto body repair establishment and ask them if they could arrange a 15-minute interview for you to speak with an auto body repair professional who has comprehensive experience in the field of frame repair. Inform them of the purpose of your request. Prepare a set of open-ended questions, such as those your instructor asked before reviewing the video. You may use the following questions as you interview the auto body repair technician:

- What type of frame would you most prefer to repair or replace, and why? What type of frame would you least prefer to repair or replace, and why?
- Why is it important to have an understanding of automobile construction in relation to proper auto body repair?
- In your opinion, what do you think is the most challenging aspect of auto body repair?
- What is a typical day like for you?
- What, if any, new technologies are being introduced that will improve accuracy and/or ease of frame repair?
- After completing your research, prepare a presentation about your discussion with the auto body repair technician. You may share your findings with the class by presenting an oral report or a PowerPoint demonstration.

### **Consulting Auto Repair Publications**

Many publications exist in the auto body repair field. Visit your local library and consult the magazine section for publications about auto body repair. Some of these publications are also available online. You may also purchase a magazine of your choice at any retail outlet. Examples of popular auto body repair magazines include:

***Automotive Body Repair News***—Monthly publication serving the collision repair industry. Aimed primarily at collision repair shop owners and technicians.  
<http://www.abrn.com/abrn/issue/issueList.jsp?id=37>

***Popular Mechanics***—Features regular columns covering many facets of automotive maintenance and repairs. “Saturday Mechanic” provides step-by-step instruction on a single complex repair, while “Maintenance Basics” covers less complex repairs. “Car Clinic” consists of questions from readers answered by editors, and covers several topics in each issue.

Locate an article about the repair of one or more frame designs. Recap the key points cited in the article in a one-page report. In your report, include the magazine name, issue, and author of the article you referenced. Also, include one fact or issue you found the most interesting, and why you found it fascinating.



## **INTERNET ACTIVITIES**

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### **Auto Construction and Crash Compatibility**

According to the Insurance Institute for Highway Safety, weight by itself is not the only factor that influences crash outcomes. Other design characteristics influence outcome as well. Log onto <http://www.hwysafety.org> and research the factors that influence property damage and death rates in relation to vehicle design. Write a one-page summary about the role weight, stiffness, and geometry play in crash compatibility.

### **Collision Repair and High Tech**

What can happen to a car's frame in a typical collision? Why is the frame so important? Can visual inspection overlook frame damage? There is a revolution going on in the way frame damage is analyzed and repaired. Visit [www.framefacts.com](http://www.framefacts.com) and click on all of the links to discover how technology is aiding auto body professionals in their diagnosis of frame damage. After completing your research, prepare a bulleted list of key elements for each of the following categories: hidden frame damage, the ways frames react in collisions, frame integrity, and inspection methods.

### **Discussion Forums**

Visit [www.autobodyonline.com](http://www.autobodyonline.com) and enter the discussion forums by clicking the "Discussion" tab in the upper left corner of the website's homepage. Post a question about vehicle frame construction. Ask about the advantages and challenges that experienced auto body repair technicians have faced when tackling repairs. Also, review the other posts within the forums and see if you can gather any other information about frame design, or about the major parts, panels, and assemblies housed in each body sections. After a week, copy all your responses, as well as any other posts you have seen that are relevant, into a word processing document. Then answer the following questions: What have you learned as a result of the answers you have received to your post? What have you learned from reading other posts? Did any of the responses conflict with one another? If so, what issues did they raise?

### **Activity Title**

Visit [www.autobodyonline.com](http://www.autobodyonline.com) and enter the discussion forums. Post a question asking about the auto body career of your choice. Ask about duties and salaries, and ask for advice about breaking into the field. Also, review the other posts within the forums and see if you can gather any other information about the career you are considering. After a week, copy all your responses, as well as any other posts you have seen that are relevant, into a word processing document. Then answer the following questions: What have you learned as a result of the answers you received to your post? What have you learned from reading other posts? Has any of the information you read changed your mind about your career choice, or has it affirmed that you made a good choice?



## ASSESSMENT QUESTIONS

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**Q:** Technician A says that repairs to a unibody vehicle are easier to perform than those in a body-over-frame vehicle because panels in a unibody vehicle are often welded or bonded into place by adhesive. Technician B says that repairs to a body-over-frame vehicle are easier to perform in comparison to other frame designs because most body parts are bolted rather than welded or bonded to the frame. Who is correct?

- (a) Technician A
- (b) Technician B
- (c) Both A and B
- (d) Neither A nor B

**A:** (b)

**Feedback:** Due to the simplified structure of the body-over-frame design, repairs are easier to perform in comparison to other frame designs because most body parts are bolted rather than welded or bonded to the frame. Repair of unibody vehicles is challenging because panels are often welded or bonded into place by adhesive for structural strength. For example, removing and replacing a damaged roof or quarter panel on a unibody vehicle can be a more time-consuming repair than in a body-over-frame vehicle.

**Q:** Which one of the following frame designs is NOT a variation of body-over-frame construction?

- (a) Space frame
- (b) Perimeter frame
- (c) X-frame
- (d) Ladder frame

**A:** (a)

**Feedback:** Variations of the body-over-frame design include the perimeter frame, X-frame, combination frame, and ladder frame in which most body parts are bolted rather than welded or bonded to the frame. A space frame is a lightweight aluminum frame consisting of a strong steel cage that is covered with plastic or composite panels, which typically clip on or are adhesive-bonded to the frame.

**Q:** Which body section includes the floor pan, pillars, rocker panels (doorsills), rear bulkhead, roof, dash assembly, and doors?

- (a) Front section
- (b) Center or midsection
- (c) Tail or rear section
- (d) None of these sections

**A:** (b)

**Feedback:** The center or midsection includes the floor pan, pillars, rocker panels (doorsills), rear bulkhead, roof, dash assembly, and doors. The front section, or front-end assembly, includes everything from the bumper to the cowl—the part of the body just in front of the windshield. The rear or tail section includes the trunk floor panel, inner wheel housing, rear and lower quarter panels, and the trunk lid.



**Q:** Since there is no separate heavy-gauge steel frame under a unibody frame, how is structural strength achieved?

**A:** Structural strength of a unibody frame is achieved through the shape and design of the components, rather than by mass and weight.

**Feedback:** In unibody frame construction, a strong, structural “shell” is created for the vehicle by welding, bolting and adhesive bonding the various body parts together. There is no separate heavy-gauge steel frame under the body because none is needed. Structural strength of a unibody frame is achieved through the shape and design of the components that cause force exerted on one point of the shell to spread out or diffuse to other parts to resist breakage.

**Q:** Damaged space frame vehicles are more likely than other body types to have hidden damage. (*True or False*)

**A:** True

**Feedback:** Space frames have plastic or composite body panels that do not deform on impact the way metal does. Therefore, collision damage to the interior frame structure may be more substantial than indicated from the outside. Also, the panels may mask the extent of interior corrosion because plastic does not rust.

**Q:** Technician A says that a perimeter frame has good side impact strength because the side rails extend the full length of the vehicle and surround the passenger compartment. Technician B says that a perimeter frame has good side impact strength because front and rear crossmembers support the engine, suspension and drivetrain, and the floor pan is bolted to the center section, adding more stability and resistance to twisting loads. Who is correct?

- (a) Technician A
- (b) Technician B
- (c) Both A and B
- (d) Neither A nor B

**A:** (c)

**Feedback:** The perimeter frame, the most common type of conventional (BOF) frame in use today, has good impact strength because the side rails extend the full length of the vehicle and surround the passenger compartment; the front and rear crossmembers support the engine, suspension and drivetrain; and the floor pan is bolted to the center section adding more stability and resistance to twisting loads.

**Q:** \_\_\_\_\_ vehicles tend to be heavier than other frame types and ride higher off the ground, but are extremely strong.

**A:** Body-over-frame

**Feedback:** Body-over frame vehicles, such as pickup trucks, vans, and SUVs, tend to be heavier than other frame types and ride higher off the ground, but are extremely strong.

**Q:** What type of knowledge must auto body repair technicians possess in order to communicate effectively with coworkers, parts suppliers, and insurance adjusters?

**A:** Auto body repair technicians must be familiar with the terminology used in the auto body repair industry regarding frame styles, and major parts, panels, and assemblies housed in each body section.

**Feedback:** To communicate effectively with coworkers, parts suppliers and insurance



adjusters, auto body repair technicians must be familiar with the terminology used in the auto body repair industry, such as the name of frame styles, body sections, parts, assemblies, and panels. Auto body repair professionals must also be familiar with all of the various automotive parts and the way in which they interrelate in order to properly diagnose and repair damaged vehicles.

**Q:** How does vehicle construction impact the work of auto body repair technicians?

**A:** Vehicle construction impacts the extent of damage, the time needed to make necessary repairs, the potential for hidden damage, and the ease in which repairs are performed.

**Feedback:** Frame design and the manner in which vehicle parts are fastened to the structure will determine the extent of damage, the time needed to make necessary repairs, the potential for hidden damage, and the ease in which repairs are performed.

**Q:** All vehicle parts and assemblies are directly attached to a separate frame. (*True or False*)

**A:** False

**Feedback:** All vehicle parts and assemblies are attached directly or indirectly to the vehicle frame. In unibody frame construction, a strong, structural “shell” is created for the vehicle by welding, bolting and adhesive bonding the various body parts together. There is no separate heavy-gauge steel frame under the body because none is needed. In space frame construction, a lightweight aluminum frame consisting of a high-strength steel “cage” is covered with plastic or composite panels, which typically clip on or are adhesive-bonded to the frame.

## **ADDITIONAL RESOURCES**

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### **WEB SITES**

#### **Auto Body Online**

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

#### **Auto Body Pro**

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

#### **Auto Body Tool Mart Repair and Restoration Tutorials**

[www.autobodytoolmart.com/restorations.html](http://www.autobodytoolmart.com/restorations.html)

#### **Auto Glossary**

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

#### **Automotive Body Repair News**

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

#### **Automotive Services Association**

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

#### **Automotive Youth Educational Systems (AYES)**

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



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

<http://auto.howstuffworks.com>

## **I-car**

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

## **National Automobile Dealers Association Ethics Guide**

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

## **National Automotive Technicians Education Foundation**

[www.natef.org/program\\_standards/collision/index.cfm](http://www.natef.org/program_standards/collision/index.cfm)

## **Society of Collision Repair Specialists**

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

## **Vocational Information Center: Auto Body Career Resources**

[www.khake.com/page11.html](http://www.khake.com/page11.html)

## **Bureau of Labor Statistics—Automotive Body and Related Repairers**

[www.bls.gov/oco/ocos180.htm](http://www.bls.gov/oco/ocos180.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

Freund, Ken, et al. *The Haynes Automotive Electrical Manual*. Newbury Park, CA: Haynes Pub. Group, 2000. ISBN: 1850106541

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**

### **Auto Shop Safety, VHS/DVD, Meridian Education**

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.

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### **Multimedia Auto Shop Safety, CD-ROM, Shopware**

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