Straightening Aluminum Program 1

Textbook

I-CAR®

IMPORTANT NOTICE

This material provides general directions for collision damage repair using tested, effective procedures. Following them will help assure the reliability of the repair.

I-CAR cannot accept responsibility for any individual repair, nor can it warrant to the quality of such repair. Anyone who departs from the instructions in this program must first establish that neither personal safety nor the integrity of the repair of the vehicle is compromised by the choice of methods, tools, or supplies.

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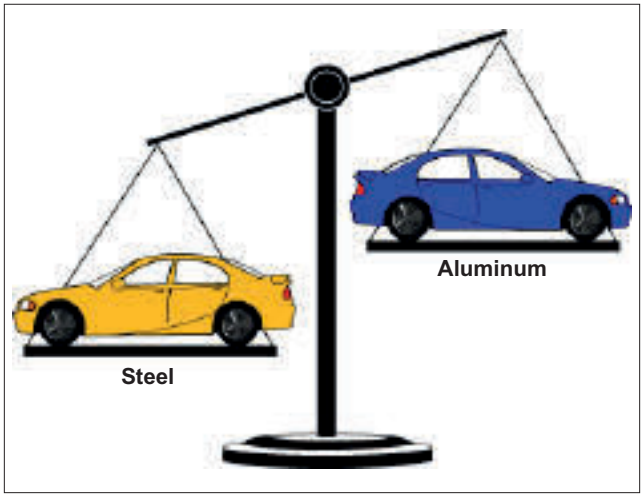
All recommendations presented in this program are based upon research programs or upon tests conducted by laboratories, manufacturers, or selected collision repair facilities. If performed as outlined, these recommendations will provide the basis for a thorough, professional repair.

CONTENTS

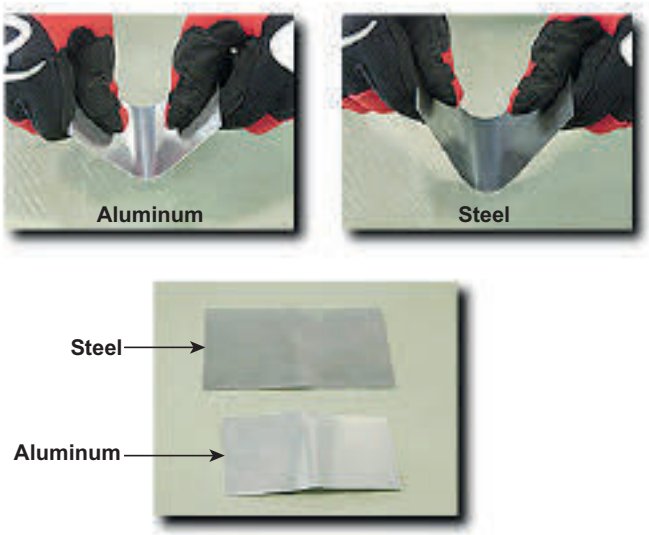
Topic A. Characteristics Of Aluminum



A-2 Aluminum can reduce the weight of a vehicle by several hundred pounds.

Aluminum usage in the automotive industry has increased. Government regulations on fuel economy and the desire for driving larger vehicles has forced vehicle makers to use a lighter, yet durable material. Aluminum is one way that vehicle makers have met these demands. Some of the advantages of aluminum include its:

- durability.
- strength.
- corrosion resistance.
- light weight.
- ability to be recycled.
- availability.



A-3 Steel will returns to its previous state easier than aluminum.

The molecular structure of aluminum is different than steel. When aluminum is formed or damaged, it wants to stay in the shape that it is in.

Audi A-8 Hood

A-4 This aluminum hood would be very difficult to repair.

Aluminum will hold the existing shape that it is in. Therefore, a lot of force will be required to repair a collision-damaged panel back to its original design. Aluminum has the following properties:

- Is strengthened by the forming process
- Collision damage makes it even stronger
- Will require a lot of force to get back into the original shape

WORK HARDENING

Select the Demonstration Icon found on screen A-4 of your CD-ROM for a demonstration on the effect of work hardening on an aluminum panel.

Topic B. Aluminum's Physical Properties

B-1 Aluminum tends to hold it's existing shape.

Aluminum is different than steel. When it is damaged, it will hold the existing shape that it is in, meaning it no longer has the memory of the previous shape. Different alloys of aluminum create different strengths and degrees of flexibility, but as a general rule, aluminum will crack easier than steel.

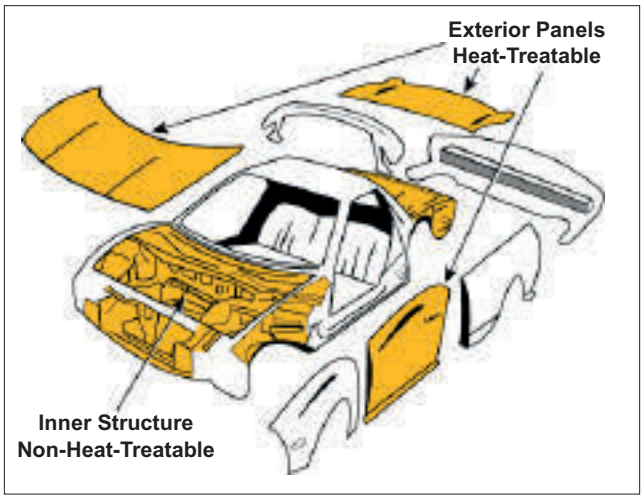
FLEXIBILITY OF ALUMINUM VS. STEEL

Select the Demonstration Icon found on screen B-1 of your CD-ROM for a demonstration of the flexibility of aluminum versus steel.

Topic C. Alloys

C-1 All of these vehicle parts are constructed of aluminum.

The first digit in the alloy number is what series the alloy belongs to. Adding different elements to aluminum in the alloying process creates different alloys. The element added to the aluminum will determine how much strength the alloy will have. This process creates aluminum with properties better suited to the application.



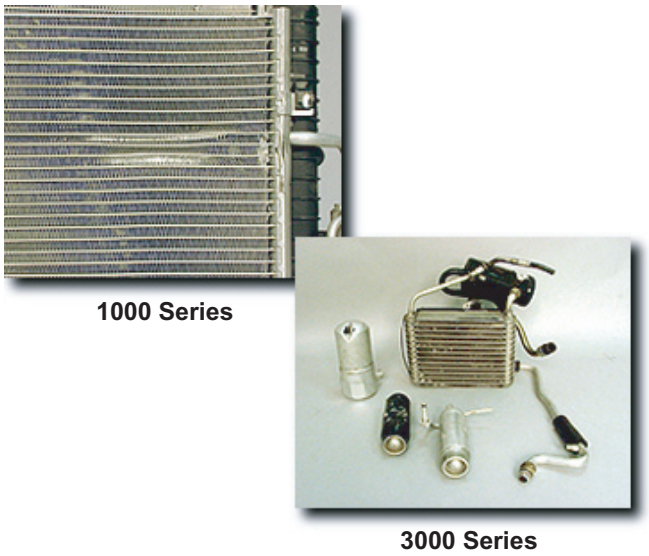
C-2 Heat-treatable and non-heat-treatable aluminum alloys are used in different areas of the vehicle.

Heat-treatable alloys are alloys that gain strength when heated. Non-heat-treatable alloys gain their strength by work hardening and cold-forming. Both heat-treatable and non-heat-treatable alloys may be heated during repairs.

C-3 LEFT: The hood on this Ford truck is made of 6000 series aluminum. RIGHT: Front bumper reinforcements may be made of 7000 series aluminum.

Heat-treatable alloys may be heated to gain strength. The majority of exterior body panels are made using heat-treatable aluminum. This group of alloys includes:

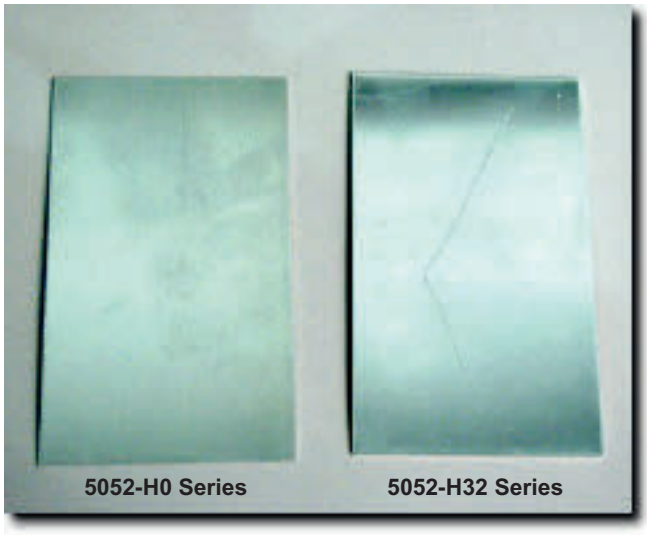
- 2000 series. This series of aluminum is alloyed with copper. An example is outer and inner body panels.
- 6000 series. This series of aluminum is alloyed with magnesium An example is exterior body panels.
- 7000 series. This series of aluminum is alloyed with zinc and small amounts of magnesium or copper. 7000 series aluminum is very strong. An example is bumper reinforcements.



C-4 LEFT Radiator fins may be constructed of 1000 series aluminum. RIGHT 3000 series alloy aluminum may be used for air conditioning lines.

Non-heat-treatable alloys are alloys that cannot be heat-treated to gain strength. The strength of these is due to cold forming. Many of the vehicles with aluminum structures use non-heat-treatable alloys for the inner structure. This group of alloys includes:

- 1000 series. This series of aluminum is over 99% pure. An example is electrical wire.
- 3000 series. This series of aluminum is alloyed with manganese. An example is inner structure on vehicles.
- 4000 series. This series of aluminum is alloyed with silicon. An example is welding electrode wire.
- 5000 series. This series of aluminum is alloyed with magnesium. An example is inner structure on vehicles.

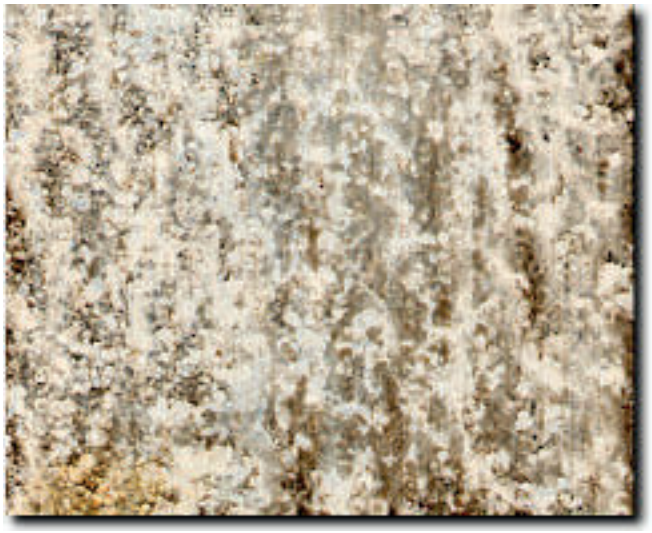


C-5 A higher temper of aluminum will make it less prone to scratching.

The physical and mechanical properties of aluminum are known as its temper. The temper is identified by the suffix that follows the alloy number. For heat-treatable alloys, this suffix begins with the letter "T" for temper. Non-heat-treatable alloys use the letter "H" for hardness. Softer alloys of aluminum scratch easier than the harder alloys. Some of the harder alloys are comparable to steel in dent and scratch resistance.

SCRATCH EFFECT OF DIFFERENT TEMPERS
Select the Demonstration Icon found on screen C-5 of your CD-ROM for a demonstration of how different tempers of aluminum scratch.

Topic D. Corrosion



D-1 This is a microscopic view of the oxide layer on an aluminum coupon.

Aluminum is naturally corrosion resistant due to an oxidation barrier. The aluminum forms this barrier immediately after contact with air. This barrier must be removed before any sanding, filling, or painting can be done.

D-2 This is an example of galvanic corrosion.

Galvanic corrosion, also called sacrificial corrosion, occurs when two different metals are in contact with each other with the presence of an electrolyte. An electrolyte is a non-metallic conductor of electricity. For example, if a bare aluminum panel comes in contact with a bare steel fastener, the aluminum will corrode to protect the steel fastener. Coated fasteners, washers, or gaskets can be placed in between the dissimilar metals to prevent galvanic corrosion.

D-3 Filiform corrosion spreads in thin filaments under the paint finish.

Filiform corrosion is the creeping type of corrosion that develops under paint film. This usually occurs when bare aluminum is not cleaned properly and the paint film gets damaged. Moisture, an electrolyte, will get beneath the paint film and corrode the metal.

Topic E. Workplace Considerations

E-1 Curtains can be used to separate the steel repair area from the aluminum repair area.

Work areas for aluminum repair and for steel repair should be kept separate to avoid contamination between steel and aluminum. This can be accomplished by:

- setting aside a designated work area for aluminum repair.
- using curtains and walls to separate aluminum repair areas from steel repair areas.

E-2 Dust and fume extractors can be used to trap airborne metallic particles.

Airborne steel particles from sanding and grinding can lead to contamination of the aluminum. Ventilation can reduce the amount of metal particles and sanding dust in the air. Attachments on sanding equipment enable the tool to be hooked into a vacuum to remove dust and sanding particles.

Topic F. Tools Used On Aluminum

F-1 Many of the hand tools used on aluminum repairs are similar to the ones used on steel repairs.

Some of the hand tools used for aluminum repair include:

- hammers.
- dollies.
- slappers.
- spoons.
- picks.

F-2 A dedicated tool box will help keep aluminum tools and abrasives separate.

Cross-contamination can be prevented by keeping tools and abrasives used on steel separate from the ones used on aluminum. This can be accomplished by labeling or color coding tools and abrasives.

F-3 Pneumatic tools can be wiped down with a clean cloth before use on aluminum.

Power tools may be used between steel and aluminum. The housing should be cleaned to remove any contaminants with a clean towel. Compressed air could cause particles to become airborne so is not recommended. Tools used for cutting such as drill bits and saw blades should be kept separate.

F-4 A file can be used to remove any nicks on the hammer face.

Some tool maintenance items that will prevent contamination or damage to the aluminum include:

- cleaning the tool after use.
- repairing any nicks or gouges in the hammer face.
- keeping all hand tools used on aluminum separated from steel.

F-5 These are examples of hammers that can be used for aluminum repair.

Hammers used when repairing aluminum should not have nicks and gouges in them. Aluminum is softer than steel and may be damaged by sharp edges of a hammer. Hammers used on an aluminum repair may include:

- plastic-faced.
- polished steel face with edges rounded off.
- wooden-faced.
- aluminum-faced.

Shrinking or serrated-faced-hammers should NOT be used because they may damage or thin the aluminum.

F-6 Dollies used for aluminum repairs should be identified.

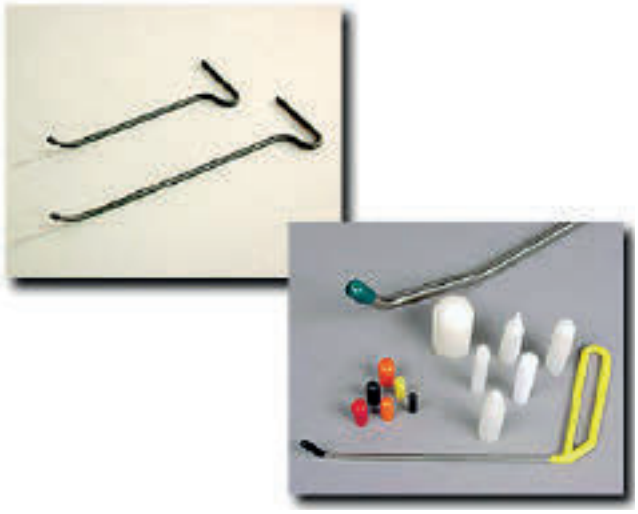
Dollies used for aluminum repair include:

- polished steel.
- lead shot.
- wood.
- rubber.

F-7 Slappers and spoons that may be used to remove damage.

Slappers and spoons may be used to remove high and low areas on the panel. These may include:

- wood with leather face.
- spring steel.
- polished face.



F-8 Picks are used to raise low spots.

Picks can be used to push up low areas when there is limited access to the back of the panel. Picks should have polished, rounded tips so that they do not damage the panel. A plastic boot can be placed over the tip to prevent scratches and damage to the inner panel.

Topic G. Review

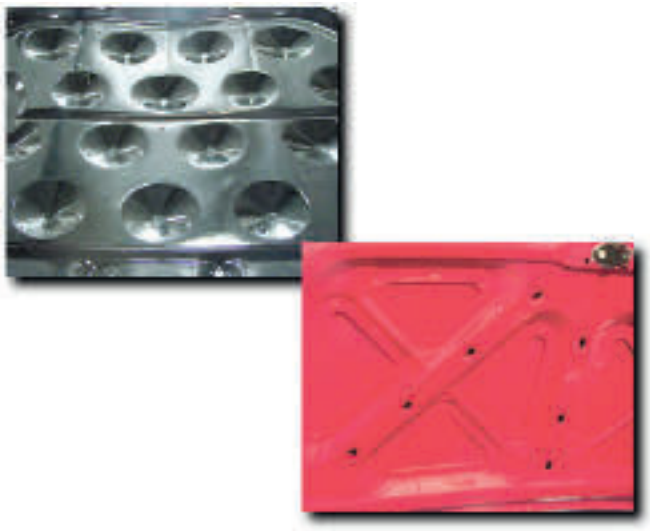
REVIEW
Refer to screens G-1 through G-2 of your CD-ROM for review questions on the characteristics of aluminum.

Topic A. Damage Analysis

A-2 The damage to the adjacent panels will affect the repair plan.

Some items to consider when developing a repair plan are:

- access to damage.
- paint condition.
- blending considerations for refinishing.



A-3 A muffin pan designed hood and an open paneled hood use different methods to support the outer panel.

The decision to repair a panel versus replace a panel may be based on the vehicle maker's recommendations. This information can be found in the body repair manual. Some vehicle makers have recommendations on the techniques used to repair tears and dents in cosmetic panels. Access to the damage and the extent of the damage should be taken into consideration.

A-4 A non-ferrous film thickness gauge may help produce a repair plan.

A-5 The fender on this vehicle allows access to the backside when the fender liner is removed.

The condition of the paint film may determine how the repairs will be made. If the paint film is damaged, paintless dent repair (PDR) will not be an option. The paint film thickness may also influence repairs. The film thickness will have to be checked using a non-ferrous film thickness gauge. If the paint film thickness is not in the acceptable range, the paint may have to be removed before repairs.

When there is access to both sides, tools that may be used include:

- hammer and dolly.
- picks.
- weld-on studs
- spoons and slappers.
- paintless dent removal (PDR) equipment.

A-6 The muffin pan design allows very little access to the inside of the outer panel.

Some of the options when there is limited or no access the back of the panel may include:

- use of heat to remove dents.
- use of hot-melt glue pulling tabs.
- dedicated weld-on dent removal equipment.
- suction cups.

Topic B. Types of Damage

B-1 The scratch in this door is an example of direct damage.

Direct damage is the area that is at the point of initial impact. This type of damage may include dents, tears, and cracks.

B-2 The high spots surrounding the scratch is indirect damage.

Indirect damage includes:

- areas around the direct damage that requires repair.
- hidden damage.

B-3 The fender in this photo may need to be partially restored before straightening the door.

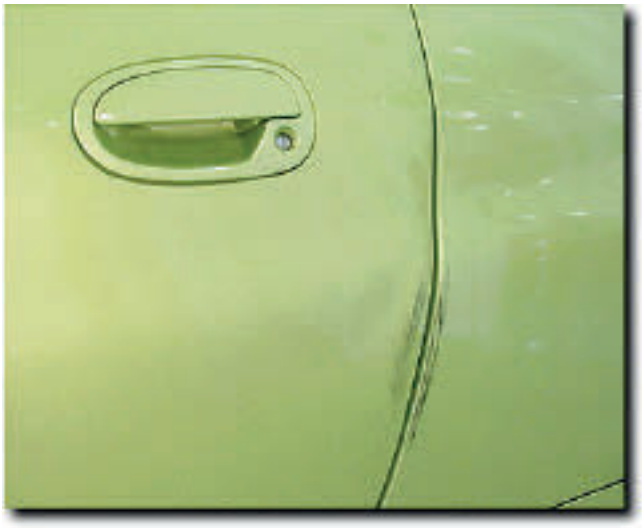
The location of the damage and whether adjacent panels are damaged should be considered. The damage to an adjacent panel may have to be partially repaired to obtain the proper contours and panel gaps. There may also be inner structure in the way so access to the back of the panel may be limited.

B-4 The hood on this truck is an example of a convex panel.

Damage to a convex panel, a panel that curves outward, is usually repaired from the indirect damage toward the direct damage. Use caution to avoid creating a high spot and stretching the metal.

B-5 This quarter panel curves inward meaning it is a concave panel.

Damage to a concave panel, a panel that curves inward, may be repaired similar to a convex panel, from the outside inward. Damage to this type of panel often includes some hidden indirect damage. A sanding board can be used to determine the extent of the damage.



B-6 This quarter panel damage will be restored by starting with the body feature line.

Damage to a panel may be repaired by:

- restoring the feature line first.
- repairing the surrounding damage using the rule "last in, first out."

Although the "last in, first out" method may applies, there are some exceptions such as edges of panels and body feature lines. There are many techniques to repair damage, with none being incorrect.

B-7 The tear in this panel should not be repaired.

Welding cracks and tears depends on the:

- vehicle maker's recommendations. Some vehicle makers require panel replacement in the event of a crack or tear.
- extent of the damage.
- type of welding to be performed.

B-8 This is the GTA or TIG welding method.

If tears can be repaired, the two types of welding techniques that can be used are:

- Gas Metal Arc (GMA) welding, also known as Metal Inert Gas (MIG) welding.
- Gas Tungsten Arc (GTA) welding, also known as Tungsten Inert Gas (TIG) welding. When using TIG, the panel is usually removed from the vehicle.

REPAIRING A TEAR

Refer to screen B-9v of your CD-ROM for a video on repairing tears on aluminum panels.

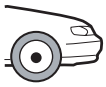
To protect computers and other sensitive parts from damage:

- follow the vehicle maker's recommendations for recording and resetting electronic memories.
- ensure that the ignition switch is in the lock position, and the key is removed.
- disconnect and isolate the negative battery cable, and disarm the passive restraints system. Follow the vehicle maker's recommendation.
- carefully remove computer modules, when welding or heating within 300mm (12"), or a greater distance when recommended by the vehicle maker.
- protect computer modules, connectors and wiring from dirt, heat,static electricity and moisture.
- loosen or remove any wiring harnesses or electrical parts that could be damaged during the repair process.
- route welding leads 90° to any wire harness whenever possible. Consider other vehicles that may be positioned near the welding equipment.
- remove or protect the battery if it is near an area to be welded or heated. Batteries may release explosive gasses that can ignite when heat or sparks are present.

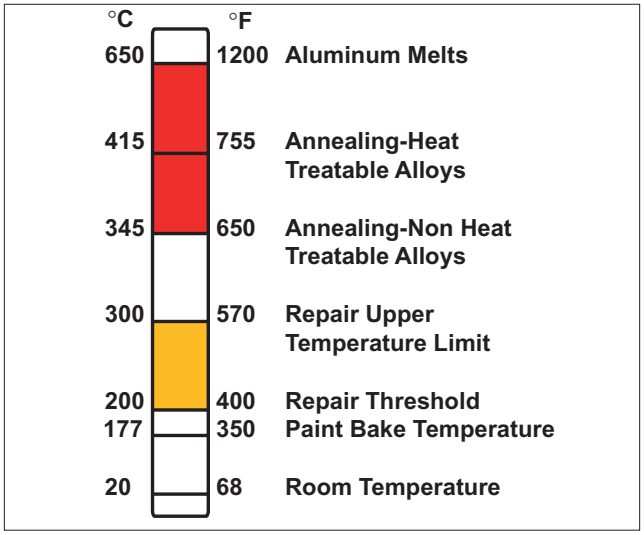
Topic C. Heating Aluminum

C-1 The repair area on this door is heated with an oxy-acetylene torch.

Using heat to soften the aluminum can be an effective way to remove damage from aluminum panels. At elevated temperatures, aluminum is softened making it easier to work out dents. It is important to not heat areas where adhesive is present because this could lead to adhesive failure.



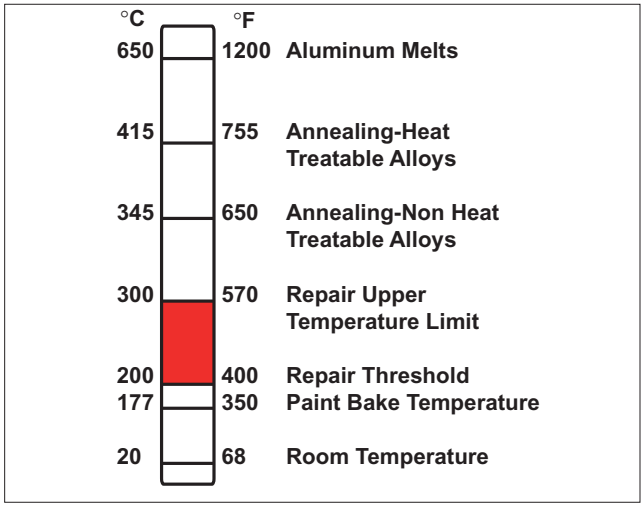
All noise, vibration, and harshness (NVH) material should be removed from the backside of a panel before heating.



C-2 This chart shows how heat effects the physical properties of aluminum.

When heating aluminum, consider that:

- aluminum does not change color when heated to melting point.
- approximate melting points of most alloys is 640° C (1,184° F).
- steel melts at 1,500° C (2,732° F).
- heat spreads faster on aluminum.



C-3 The highlighted area shows the repair temperature of most aluminum alloys.

The repair temperature window for aluminum is:

- 200° C (400° F) to 300° C (570° F).

The panel to be repaired should be kept within this temperature window to eliminate permanently softening (annealing) the aluminum.

C-4 Here are some examples of heat indicators.

Heat indicators can be used to monitor the amount of heat that is put on a panel to get the panel to the proper repair temperature. The heat should be monitored as close to the heat source as possible. Some examples of heat indicators include:

- heat detection crayons.
- heat monitoring strips.
- heat detection paints.
- noncontact thermometers.

A noncontact thermometer reading may vary when checking bright metallic surfaces. Some noncontact thermometers have a calibration for emissivity. Emissivity is the ratio of the radiant energy emitted from a surface to that emitted from a black surface at the same temperature.

HEAT INDICATORS

Refer to screen C-5v of your CD-ROM for a video on using heat indicators.

C-6 Heating a panel without monitoring the temperature may result in annealing.

Annealing the aluminum consists of heating the alloy to a specific temperature and allowing it to cool to room temperature. This specific temperature is known as the annealing temperature. Annealing will cause the aluminum to soften permanently. Annealing is generally not recommended in the repair process due to the fact that the original properties of the alloy are lost.

C-7 LEFT: This panel is heated with a torch during the straightening process. RIGHT: A non-contact thermometer is used to monitor the temperature.

The repair method may include using heat to soften the aluminum. When using heat, the aluminum is less likely to crack. The heat must be monitored to obtain the repair temperature and avoid reaching the annealing temperature. Corrosion protection should be reapplied to the inner panel after the repair.

HEAT TRANSFER ALUMINUM VS. STEEL

Select the Demonstration Icon found on screen C-7 of your CD-ROM for a demonstration of how the heat spreads on aluminum and steel.

C-8 An induction heater can be used to heat a damaged area on this aluminum hood.

Heating the aluminum can be effective in the repair process. Thermal expansion will cause the metal to expand and relieve the internal stresses, allowing the metal to return to the original contour. As the aluminum cools, it contracts causing the metal to return to the original shape. Heating in a circular motion around the dent can remove or greatly reduce the size of the dent.

USING HEAT TO REMOVE DENTS

Select the Demonstration Icon found on screen C-8 of your CD-ROM for a demonstration of how to remove or reduce the size of dents using heat.

Topic D. Basic Repair Methods

D-1 Panels should be cleaned with a solvent based wax and grease remover.

Surface preparation is an important part of the repair. To prepare an aluminum panel for repairs:

- wash the panel with soap and water.
- clean with wax and grease remover.
- inspect the panel for damage to the finish.
- identify areas of damage.

D-2 TOP: A hand sanding board is used to locate damage. BOTTOM: Notice how the low areas stay black and guide coat is removed from the high areas.

High spots and low spots can be located in the panel with the aid of a sanding board using P80 grit or finer sandpaper. The board will remove the paint on the high areas and leave it in the low areas. A guide coat can also be used to make the repair area more visible.

A vixen file may remove too much material. The file should be dulled and have the sharp edges removed.

D-3 The finish is removed using P80 grit sandpaper on a dual action sander.

Before the metal work is performed, the paint finish may need to be removed from the repair area using P 80 grit or finer sandpaper. This will help when heating the panel. Damage to the edges and body feature lines are generally restored first due to work hardening.

D-4 The dolly is held off to the side of where the hammer will strike.

D-5 The hammer strikes the panel with the dolly directly below.

The hammer-off-dolly technique is the preferred method of repairing damage to aluminum. The dolly is positioned to raise low areas on the backside of the panel. The hammer strikes the panel slightly to one side of where the dolly is held. The positioning of the dolly in relation to the hammer makes this effective because the high areas are being lowered and the low areas are being raised at the same time.

The hammer-on-dolly technique can be used to remove pick marks and small high spots. The use of the hammer-on-dolly method is generally not preferred on aluminum and should be kept to a minimum due to the fact that it may thin and stretch the aluminum. When using the hammer-on-dolly technique, the:

- dolly is held directly below damage.
- hammer is used to strike the high spot.

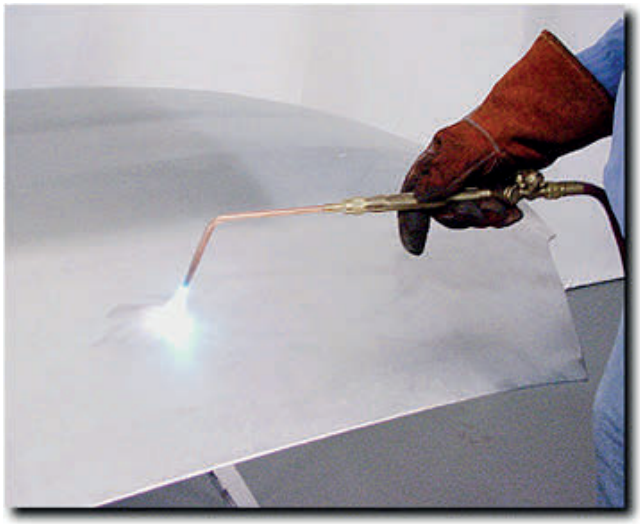
DENT REMOVAL USING HAMMER AND DOLLY

Refer to screen D-6v of your CD-ROM for a video on using a hammer and dolly to repair damage.

D-7 The area is being featheredged with P180 grit sand paper on a dual action sander.

When the panel is back to near the original contour:

- determine whether plastic body filler is needed.
- featheredge the area.
- prepare area for primer if necessary.



D-8 Heat shrinking can be done on aluminum panels with a torch.

Stretched metal can be a challenge on an aluminum repair. This condition is usually identified by the "oil can" effect. Stretched aluminum can be remove by heat shrinking. Some important considerations when shrinking aluminum are:

- heat must be monitored.
- do not reach annealing temperature.

Backside paint damage should be treated with an epoxy primer and corrosion protection material.

Induction Heater

Oxyacetylene

D-9 LEFT: An induction heater uses magnetism to generate heat. RIGHT: An oxy-acetylene torch may be used to shrink stretched panels.

Heat shrinking stretched can be done using:

- an oxy-acetylene torch.
- an induction heater.
- a propane torch.

An induction heater uses a magnetic field to create eddy currents. These currents cause heat to be generated.

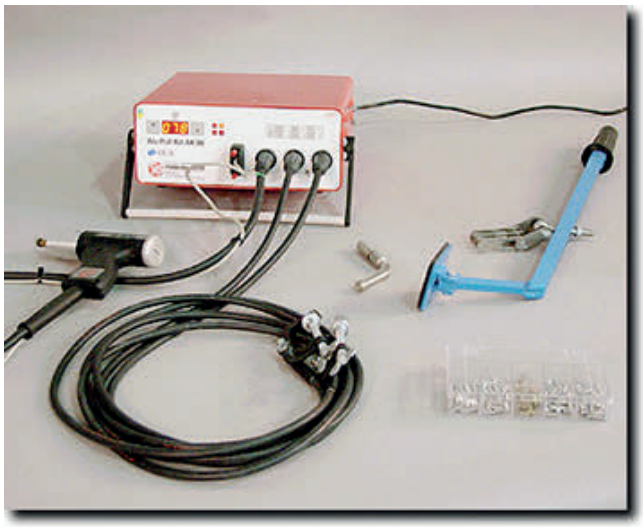
D-10 Dye penetrants use a dye and a developer to make cracks visible.

Dye may be used to make cracks more visible. The dye is sprayed on the area of damage. After allowing it time to dry, a developer is sprayed on the area. The developer will coat the panel. The dye will soak through the developer, indicating a crack.

USE OF DYE PENETRANTS TO LOCATE CRACKS

Refer to screen D-11v of your CD-ROM for a video on using dye penetrant to locate cracks.

Topic E. Weld On Dent Removal



E-1 This tool welds threaded studs on aluminum panels so that dents can be pulled out.

There is equipment designed specifically for the removal of dents in aluminum panels. This equipment welds a threaded stud onto the panel. A washer with a threaded insert is then fastened to the stud. The washer is used for pulling out the low areas. This equipment uses a capacitor to create enough energy to weld the stud onto the panel. Weld-on dent removal tools:

- can be used when there is limited access to the backside of the panel.
- for aluminum requires much more current than steel weld-on dent removal tools such as a stud gun.
- for aluminum should be used for aluminum only.

Before using this type of equipment on a vehicle, take the necessary precautions to prevent damage to the electronic systems on the vehicle.

E-2 The finish is removed from this door using a dual action sander.

The sequence for removing a dent is:

1. Identify the area of the dent using a sanding board or vixen file.
2. Remove the finish using P80 grit or finer sandpaper.
3. Attach the ground clamp.

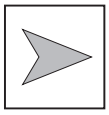
E-3 The proper settings are obtained by making practice welds.

4. Test the equipment on similar aluminum sheet to get heat settings. This will reduce the chance of burning through the panel. It will also ensure that there is enough heat to attach the pulling pin to the panel.

E-4 The leverage bar raises the low areas while a slapper lowers the high spots.

5. Start on the area that is least damaged.
6. Work towards the center of damage.
7. Use caution not to over-pull the damage, creating a stretched condition.

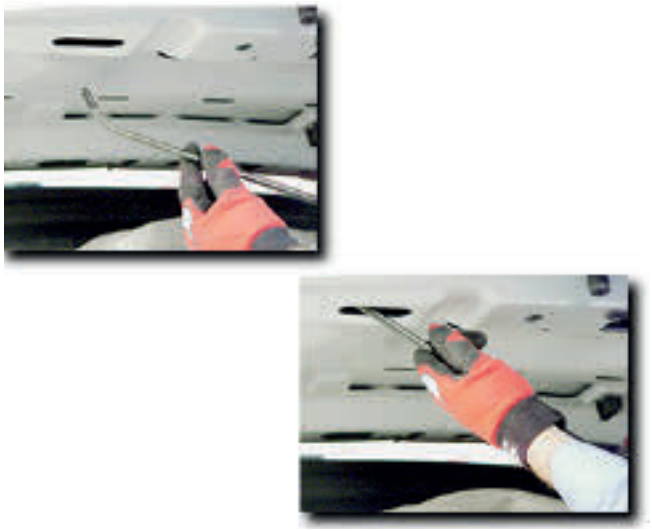
A fire extinguisher should be easily available when using dedicated dent pulling equipment on aluminum panels.



WELD-ON DENT REMOVAL EQUIPMENT

Refer to screen E-5v of your CD-ROM for a video on using weld-on dent removal equipment to remove damage from an aluminum panel.

Topic F. Picks and Prys



F-1 LEFT: The tip of this pick has a plastic tip. RIGHT: An existing hole in the inner structure provides access to the damage.

Picks can be used to repair damage in a panel that has limited access to the backside. A pick is inserted in between the inner panel and outer panel and leverage is used to raise the low areas. The inner panel may be used as a fulcrum, but caution should be used to prevent damage. Do NOT drill holes in the panel to obtain access to the panel backside.

REPAIRING A DENT IN AN ALUMINUM PANEL

Select the Activity Icon on screen F-1 of your CD-ROM and have your Instructor lead you through the Repairing A Dent In An Aluminum Panel Activity.

USING A PICK

Refer to screen F-2v of your CD-ROM for a video on using a pick to repair a dent.

Topic G. Glue-On Dent Removal

G-1 TOP: This glue-on dent removal kit includes a slide hammer, glue-on attachments, release agent, and a hot-melt glue gun. BOTTOM: The slide hammer is used to pull out on the dent.

There are glue-on dent removal systems available. This system uses attachments that are glued onto the panel with hot melt glue. The attachment is used to pull out on low spots and enable the high spots to be tapped down.

G-2 This is a bridge that is used with hot melt glue attachments.

Glue-on tools can also use a "bridge" assembly that will push down on high areas and raise the low area. The base, or bridge, is positioned around the dent on areas that could be high spots. The attachment is threaded and when the wing nut is tightened, the low spot is lifted while the high spot is pushed down.

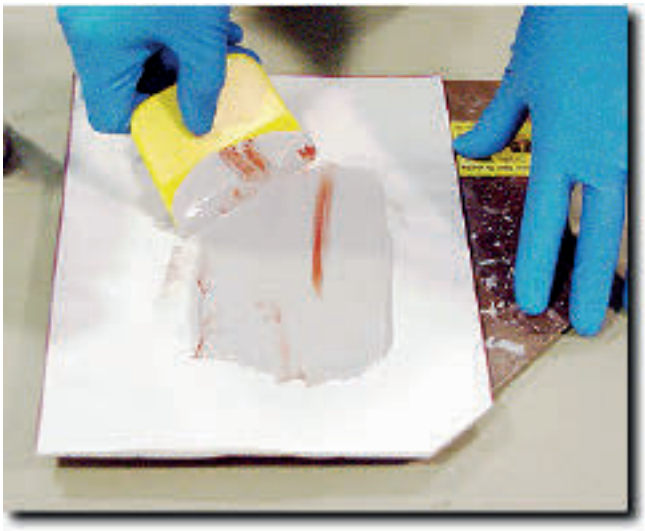
GLUE-ON DENT REMOVAL TOOLS
Refer to screen G-3v of your CD-ROM for a video on glue-on dent removal.

Topic H. Body Fillers

H-1 There are several types of body fillers that can be used on aluminum.

Using body filler on an aluminum vehicle may require the use of an epoxy primer before the application of the body filler. This information may be found in the body repair manual.

A vapor respirator and safety glasses should be worn when using polyester body fillers.



H-2 The streak in this body filler indicates that it needs to be mixed more thoroughly.

H-3 The repair area is sanded with P80 grit sandpaper to give the body filler a scratch to adhere to.

Polyester body fillers consist of:

- polyester resin.
- catalyst.
- talc.

Body filler may also contain:

- fiberglass fibers.
- fiberglass beads.
- aluminum flake.

If an epoxy primer is not required:

- sand bare aluminum with P80 grit or finer sandpaper.
- remove dust using a vacuum. Do not use compressed air for removing dust from aluminum panels.

H-4 Some vehicle makers recommend using an epoxy primer before body filler application.

If epoxy primer is required:

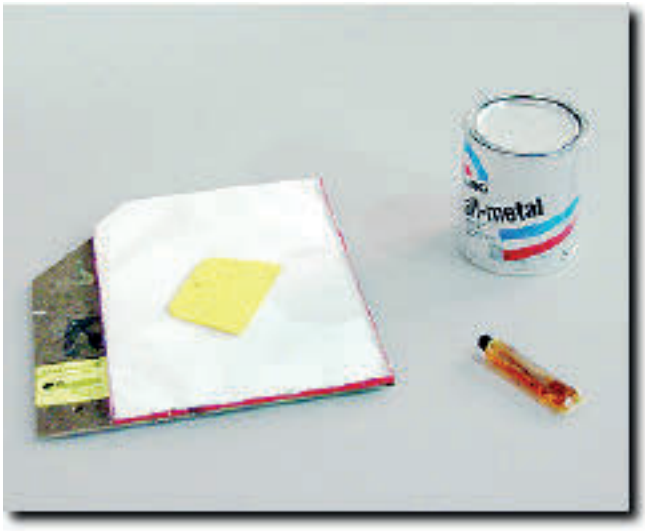
- sand with P80 grit sandpaper.
- featheredge the repair area.
- remove sanding dust.
- apply metal cleaner, if required.
- apply conversion coat, if required.

H-5 The epoxy primer should be scuffed before body filler is applied.

If epoxy primer is required:

- mask vehicle to prevent overspray.
- prime following paint maker's procedures.
- sand the cured primer following product maker's recommendations.

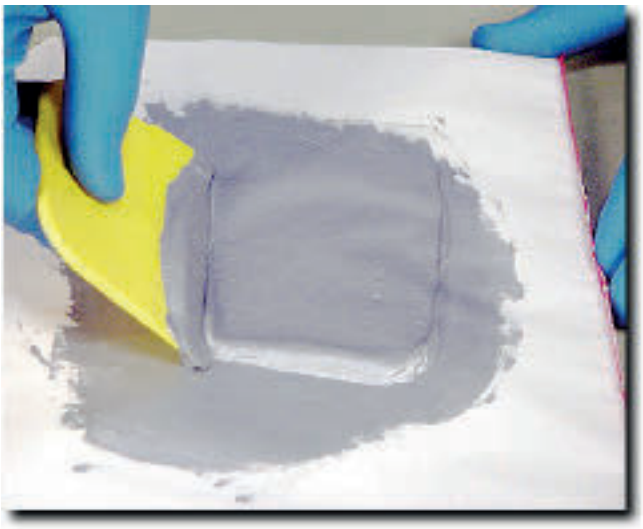
Topic I. Mixing And Applying Body Fillers



I-1 This body filler uses a liquid catalyst.

When using body filler:

- follow the product maker's procedures for the proper mixing ratio.
- fold in the catalyst. Do not stir the body filler and catalyst.
- the curing time will vary with different temperatures.



I-2 This body filler contains aluminum particles.

When mixing body filler,

- mix the body filler and the catalyst until streaks disappear.
- mix on a nonporous mixing board.

I-3 This is an example of filler with too much hardener added.

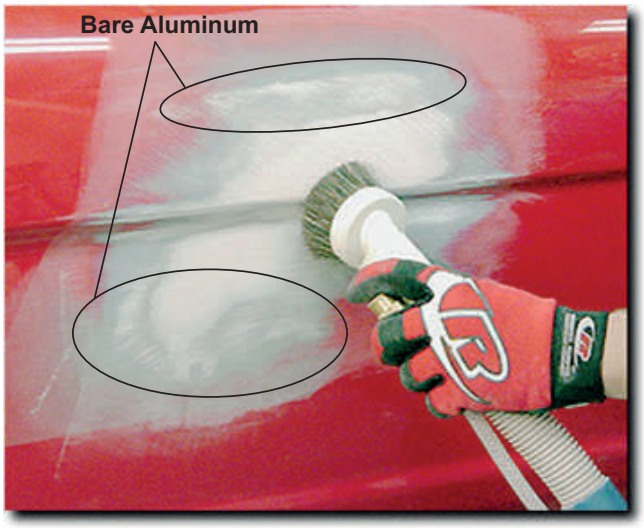
The incorrect amount of hardener can lead to:

- poor adhesion.
- pinholes.
- staining of topcoats. Staining is when the color from the body filler bleeds through the topcoat leaving a stain.
- inconsistent cure times if the wrong amount of hardener is added.

I-4 The body filler is applied with smooth, even strokes.

When applying body filler, apply:

- a thin layer, forcing filler into scratches.
- additional filler to a slightly higher level than the damage to allow for sanding.



I-5 Bare aluminum must be reprimed if an epoxy primer is recommended.

The cured filler should be sanded before additional filler is applied. If epoxy primer was required, any bare metal must be reprimed.

MIXING AND APPLYING BODY FILLERS
Refer to screen I-6v of your CD-ROM for a video on mixing and applying body fillers.

Topic J. Shaping Body Filler

J-1 These tools can be used for the initial shaping of body filler.

The initial shaping of body filler can be accomplished using:

- straight line sanders.
- random orbital sanders.
- hand sanding boards.

J-2 A straight line sander is used to sand the body filler on this door.

J-3 A random-orbital sander can sand body filler very quickly.

Straight line sanders use a strip of sandpaper and work in a back-and-forth motion. Straight line sanders:

- work well on flat areas.
- must continually monitor the contour of the dent.
- use P80 grit or finer sandpaper.
- are available in different lengths.

Random orbital sanders use a sanding disc that moves in a circular motion. Random orbital sanders:

- should only be used on flat areas.
- remove filler very quickly.
- must be moved around to keep from cutting grooves in filler.

J-4 This sanding board can be used for final sanding of body filler.

J-5 The remaining guidecoat indicates a low spot.

A hand sanding board is quite useful. It enables the technician to monitor work when shaping large areas and to locate high and low spots with the use of a guide coat. The contour can be restored by sanding in different directions.

Guide coats are used to locate high areas and low areas while sanding body filler or doing damage analysis on a panel. Guide coats may be packaged as:

- an aerosol can.
- a graphite powder.

J-6 The finish around the repair area can be featheredged with a dual-action sander.

J-7 The area around the damage is sanded in preparation for primer surfacer.

The repair area should be featheredged to:

- taper out broken paint edge left after initial sanding.
- remove scratches caused during sanding body filler.

The area around the repair needs to be sanded in preparation for primer. The paint maker's grit recommendations should be followed. A plastic abrasive pad can be used to scratch the paint film.

SANDING BODY FILLER
Refer to screen J-8v for a video showing different methods of sanding body filler.

Topic K. Review

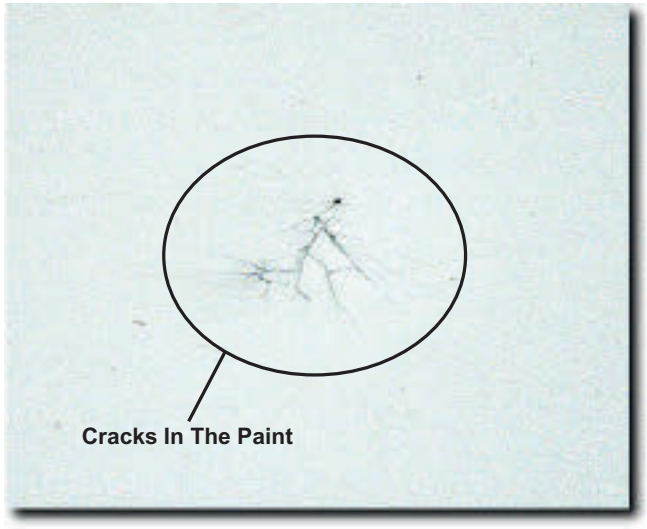
REVIEW
Refer to screens K-1 through K-3 of your CD-ROM for review questions on repairing aluminum.

Topic A. Considerations

A-2 The hood on this vehicle would probably be replaced.

Some things to consider when doing PDR include:

- the number of dents in the panel.
- access to the backside of the panel being repaired.
- possibility of damage to the paint. One way to reduce the chance of cracking the paint is to heat the area using an infrared (IR) lamp or a heat gun.
- removing all of the dent to make an invisible repair.

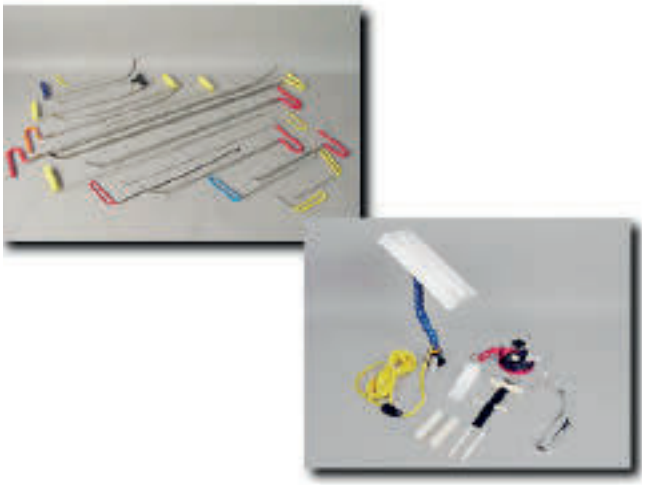


A-3 These cracks in the finish are from prying with a pick.

Applying heat to the damaged area may soften the aluminum to prevent damage to the paint. An infrared heat lamp or heat gun can be used. Damage to the exterior paint film can be the result of prying too hard on a dent. The result is the panel will have to be refinished.

A-4 This damage occurred when a pick was leveraged against the inner panel.

When PDR is performed, plastic or covered tips should be used to prevent scratches on the inside of the panel. The pick is leveraged against the inner panel so caution should be used so that the inner panel is not damaged. Holes should NOT be drilled in the inner panel to gain access to a dent. This can cause a weakness in the inner structure.



A-5 TOP: These picks are used to perform PDR. BOTTOM: This light can be used to make the dent more visible.

Some of the tools needed to perform PDR include:

- prys.
- picks.
- plastic punches and drifts. These are used to tap down small high spots
- plastic tips.
- lights to illuminate panel.
- rings to act as a fulcrum.

PAINTLESS DENT REPAIR
Refer to screen A-6v of your CD-ROM for a video on paintless dent repair.

Topic B. Glue-on Tools

B-1 TOP: This is glue-on dent removal kit that includes a bridge. BOTTOM: This kit includes a leverage puller.

When using a glue-on dent removal system for PDR, the finish should be an OEM baked finish in sound condition. The reason for this is that the glue may pull the paint away from the metal. This method can also be used for conventional repairs where refinishing may be necessary.

B-2 The attachment fits inside the slide hammer.

A slide hammer or a leverage puller is used to pull out on the low areas. When the repairs are complete, a special release agent is used to remove the attachment and the glue from the finish.

B-3 The bridge is used when there is a high area around the dent.

Glue-on tools can also use a "bridge" assembly that will hold down on high areas and pull out the low area. The base or bridge is positioned around the dent on areas that could be high spots. The attachment is threaded and when the lock nut is tightened up, the low spot is lifted while the high spot is pushed down.

Topic C. Review

REVIEW
Refer to screens C-1 and C-2 for review questions on PDR.