Corrosion Protection

Textbook

I-CAR®

Version: 3.3

CPS01-STMAN1-E

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Contents

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Introduction

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Obligations To The Customer And Liability

The collision repair industry has an obligation to correctly repair the customer's vehicle. Collision repairs must be performed using:

- recommended or tested procedures from vehicle makers, I-CAR, and other research and testing organizations.
- quality replacement parts and materials.
- repair processes and parts as written and agreed upon in the repair order. If items on the repair agreement are not consistent with the repair order, it can be considered fraud.

Performing proper collision repairs requires using parts and procedures that keep remaining warranties intact.

Collision repairs must restore:

- safety.
- structural integrity.
- durability.
- performance.
- fit.
- finish.

Throughout the damage analysis and repair process the repairer and insurer must:

- communicate with each other.
- maintain constant communication with the customer.
- be in agreement with each other and the customer on how repairs will be performed.
- inform the customer of any changes in the repair plan from the original repair agreement, and explain the changes and why they have to be made.

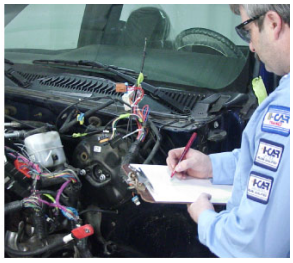
To reduce liability:

- make sure that all repairs are performed thoroughly, correctly and as listed in the damage report.
- follow proper procedures.
- have documentation of required repairs with detailed record keeping available for customers.

Technicians are considered the experts and are expected to be knowledgeable on how to perform a quality repair.

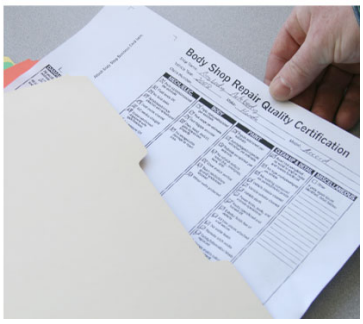
Liability insurance that covers the repair facility may not always cover all damages. For example:

- the policy may not cover faulty repairs, leaving liability responsibility completely on the facility.
- a shop owner may find that repair facility liability coverage may not cover the full amount awarded in a lawsuit. The shop owner would have to pay the difference.



It is difficult to reduce the risk of liability exposure. The part that the repairer can control is the chance of being found at fault. Chances can be minimized by:

- using recommended or tested procedures from the vehicle makers, I CAR, or other research and testing organizations.
- using quality replacement parts and materials that restore fit, finish, durability, and perform at least as well as the original.
- keeping thorough records.



Keeping thorough records includes more than recording the date, mileage, and pre-existing damage. Record keeping also includes:

- making sure all notes are legible.
- verifying the repairs that were made or not made.
- having the customer sign a waiver for repairs that they do not want performed. Repairers must determine their liability on not repairing safety systems such as restraint and anti-lock brake systems.
- keeping computer printouts or worksheets on file showing wheel alignment readings or vehicle dimensions before and after repairs.
- keeping scan tool printouts and records of computer codes for airbag, anti-lock brake, emission, and powertrain control module (PCM) systems.

- attaching the OEM or other tested procedure printout to the vehicle repair order.
- keeping receipts for all sublet work performed.

Refer to "Video: Topics Off Limits" in the presentation. This video identifies topics that should not be brought up in class.

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Module 1 - Corrosion Origins And Prevention

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Causes Of Corrosion

Learning objectives for this module include:

- describing the causes of corrosion.
- listing steps OEMs take for corrosion protection.
- describing how to prevent corrosion during repairs.

Refer to “Video: Importance Of Corrosion Protection” in the presentation. This video discusses some of the reasons why restoring corrosion protection is vital during the collision repair process.

The formation of corrosion like this requires a combination of exposed metal, oxygen, and an electrolyte.

Corrosion is an electrochemical reaction called oxidation that is formed when combining exposed metal, oxygen, and an electrolyte, such as acids, salts, or moisture.

A snow-covered road like this likely has added road salt, one of the main corrosion promoters.

Elements that promote corrosion include:

- road salt and magnesium chloride, both used to melt snow and ice on roads. Some states and regions have found that salt is not effective in very cold temperatures, so magnesium chloride is being substituted as a deicer. It is also used as a dust control agent on unpaved roads in some states and regions. Magnesium chloride is applied as a liquid. It is highly corrosive when wet, and sticks to metal surfaces better than salt.
- acid rain.
- pollutants.
- moisture.
- collision damage, which breaks coatings and exposes bare metal.

- improper collision repairs, such as when repaired surfaces are not treated.

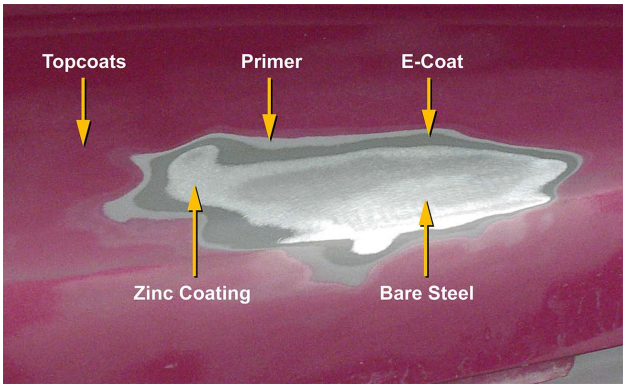
The exposed metal in this one spot is a classic example of a corrosion hot spot, where corrosion forms faster than other areas not exposed.

Corrosive hot spots:

- are so-named because they are exposed metal areas which corrode faster than other areas not exposed. Corrosion can start instantly in some cases, a condition known as flash rusting which is typically visible.
- may be a spot with a broken paint film.
- may be separated weld joints.
- may be damaged anti-corrosion coatings.

OEM Corrosion Protection

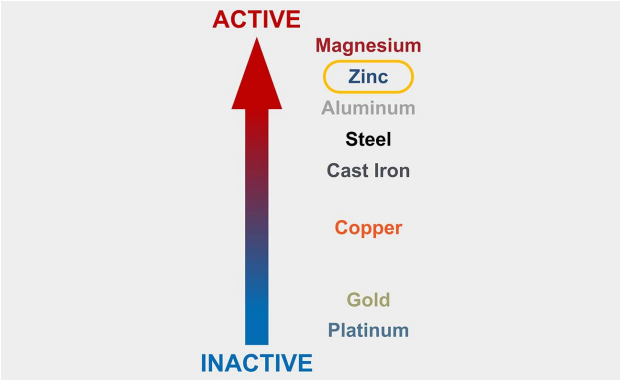
Refer to "Video: OEM-Applied Corrosion Protection" in the presentation. This video discusses some of the coatings applied at the factory for corrosion protection.



This featheredge profiles the different coatings applied by the OEM.

Corrosion protection materials applied during the vehicle original build include:

- a zinc coating at the steel mill.
- metal treatment.
- an electrodeposition coating (E-coat) process.
- seam sealers.
- chip-resistant coating.
- topcoats.
- undercoating.



This illustrated graph shows that zinc is more active than steel, which is why zinc is used for sacrificial corrosion on steel panels.

A coating of zinc on the steel:

- is applied at the steel mill before the steel is delivered to the vehicle makers.
- protects the steel with "sacrificial" corrosion. This is a type of corrosion that is not destructive. The more chemically active metal, zinc, oxidizes and forms a tight bond that does not flake off, thus protecting the steel underneath.
- is called "galvanized" and by various other names depending on the coating process. The "galvannealed" process is electroplated and heated to form a zinc-iron alloy. The process of "electrolytic galvanizing" is where sheet steel is moved past a positively charged zinc plate. Zinc is applied to the sheet steel with the help of electricity. Still another process is "hot galvanizing," where steel is dipped into a hot zinc bath.

Refer to Module 1, "Demonstration: Zinc-Coated Coupon" in the presentation for an example of a zinc-coated coupon.

The body-in-white goes through a series of washings and rinses to prepare the surface for OEM primer.

One of the first treatments of the stamped and assembled vehicle "body-in-white" at the vehicle assembly plant is metal treatment, which may be up to an eleven-step process that includes a:

- hot detergent wash and rinse, which removes grease, oil, etc.
- phosphoric acid wash, which removes scale and opens pores in the metal. A rinsing step neutralizes the acid.

- zinc phosphate acid treatment and rinse, which applies a layer of zinc crystals. The body is then baked dry to remove excess moisture from cracks and crevices.

This process prepares the body for the adhesion of the electrodeposition coating, or E-coat.

GM C/K Pickup Bed

The olive-drab color on this GM pickup bed is electrodeposition coating, or E-coat.

The E-coat process:

- charges the body and coating with opposite charges. This varies by vehicle maker, also referred to as original equipment maker, or OEM. If the vehicle body is negatively charged and the coating positively charged, it is called “cationic (CAT-ee-on-ik) electrodeposition.” If the body is positively charged, it is called “anionic (AN-ee-on-ik) electrodeposition.” The opposite charges ensure full coverage and uniform thickness.
- fully immerses the body in the charged coating, allowing the coating to reach areas that a spray gun cannot reach.
- coating is a gray, brown, or olive drab color, depending on the vehicle maker.

Saturn Ion

Seam sealers, like this sprayed bead on the inner rear body panel, are typically applied by robots.

Seam sealers are:

- designed to eliminate moisture and air intrusion wherever panels join.
- mostly applied by robots, though there are some locations on the vehicle where seam sealers are applied by hand.

Seam sealers are applied at this stage because most seam sealers, on the exterior at least, are topcoated.

Chevrolet Sonic

Textured chip-resistant coatings are most common on the lower part of the rocker panel.

A chip-resistant coating:

- is designed to cushion the impact of stones and debris from the road.
- is applied typically to lower areas vulnerable to stone chips, such as the bottom of the rocker panel.
- may be visible, especially on some Asian and European makes and models where the coating is a textured surface that is easy to see. This is most prevalent beneath the rocker panel and may be on the lower door skin. A chip-resistant coating may not even be a coating at all, but an applied plastic sheet.
- may not be visible, including non-textured coatings applied to upperbody areas such as the front of the hood and sometimes the front of the roof. These coatings are detectable only with a film thickness gauge.

Lexus HS 250h

The final topcoat layer is clearcoat, which gives the vehicle its showcase appearance.

Topcoats, including basecoat and clearcoat, are not officially part of the corrosion-protection steps but do play a role in the protection. The basecoat does not generally have corrosion-inhibiting properties, but the clearcoat:

- prevents breakdown of the finish.
- protects against ultraviolet rays.
- protects against road splash, acid rain, etc.

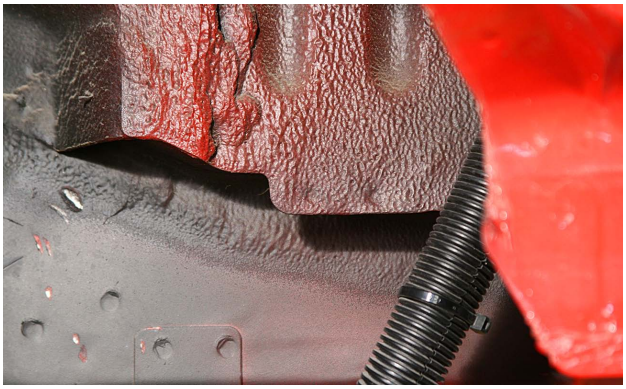
Honda Accord

The vehicle maker may add anti-corrosion compounds to inner cavities, such as inside rails.

The next step, at least for some vehicle makers, is applying anti-corrosion compounds. Anti-corrosion compounds are typically applied after the topcoats have been applied to prevent contamination of the finish. Anti-corrosion compounds are:

- generally wax-based coatings.
- applied to cavities, such as inside rails, the bottoms of door shells, and inside rocker panels.

Ford Mustang



Most vehicle makers apply a layer of stone-resistant undercoating to the inner wheelhouse.

A textured undercoating:

- is typically applied in the wheelhouse areas.
- may be applied under the floor pan. European vehicle makers are more likely to apply undercoating under the floor pan. Other vehicle makers consider the E-coat to be adequate chip protection for most of the underbody.
- provides resistance to corrosion and also vibration and wear.
- may vary in thickness and color.
- is usually petroleum-based, but some are wax-based.

Audi Q5

One of the variations of corrosion treatment is how boron-alloyed steel is protected. Audi uses an aluminum / silicon coating, such as on this Q5.

Besides the application of undercoating, there are other variations among vehicle makers on the corrosion protection coatings applied. These include the:

- composition of the phosphate coating.
- amount of chip-resistant coating. Also, the appearance of chip-resistant coating varies between vehicle makers and vehicle models.
- number of topcoats.
- application of anti-corrosion materials. European vehicle makers are more likely to apply anti-corrosion compounds than other vehicle makers. All vehicle makers require anti-corrosion compounds to be applied during repairs.

- coatings to boron-alloyed steel. Some vehicle makers, such as Ford, Audi, and Jaguar, have boron-alloyed steel coated with an aluminum / silicon coating, which resists the heating and quenching process. BMW prefers boron-alloyed steel be zinc-coated, the same as any other steel, for better weld quality. Still other vehicle makers leave this ultra-high-strength steel uncoated.

Toyota Venza

OEM service parts receive the same treatment as the rest of the full body, but the E-coat is commonly a uniform black.

OEM coatings on service parts are exactly the same as applied to entire vehicle bodies, in that:

- the steel parts begin with zinc-coated steel at the steel factory.
- there is the same full-submersion wash, rinse, and phosphate treatment.
- there is a full-submersion E-coat and baking process. The only difference with service parts is that the coating, in the end, is commonly a uniform black.

Some parts may be prepared and coated using an outside supplier, but these suppliers are held to the same standards for materials, treatment, and corrosion-resistance.

Preventing Corrosion During Repairs

Honda Accord

Restoring corrosion protection during repairs may include applying anti-corrosion compound in cavities to treat repair backsides.

Restoring corrosion protection, and preventing corrosion from occurring during the repair, should be a priority for everyone involved in the repair process.

Coatings applied by vehicle makers must be restored during repairs:

- where the coatings have been disturbed or removed. Neglecting corrosion protection can cause corrosion to form under a paint film or in an area where chipped paint occurs.
- because the steps and coatings applied by vehicle makers are there for a reason. There are no

unnecessary steps done on the assembly line or paint line at a vehicle assembly plant.
- because if not restored, corrosion damage will occur. The corrosion may only be a visible annoyance in some areas, but it speaks to the quality of the repair process.

Not addressing corrosion protection during repairs can lead to failure of the structure, like on this lower tie bar.

If corrosion protection is not restored:

- there will likely be premature failure of the part or panel.
- there may be weakening of structural parts or even failure of the vehicle structure. Hidden corrosion in a structural area can sacrifice impact protection in a crumple zone.
- the repair facility will be faced with comebacks and held liable for any injuries. Comebacks due to corrosion cost time, money, reputation, and future business lost.

Volvo S40

It is important to preserve the E-coat as much as possible, such as removing the coating only where necessary for spot welds, rather than the entire flange.

It is important to preserve the E-coat when repairing a vehicle. The E-coat:

- is the most effective corrosion-inhibiting coating that is applied to the vehicle.
- should not be broken through except where it is required or specifically recommended. Examples are in the weld zones and on structural adhesive application areas. Structural adhesive requires bare metal for adhesion, and has corrosion-inhibiting properties for protection.
- can be kept mostly intact by not grinding an entire flange. For example, on uniside replacements, for reasons of speed it is tempting to remove all of the coatings on the mating flange, not just the weld areas. Not grinding the entire flange will also help protect the zinc coating, which also should not be removed unless recommended by the vehicle

maker. The zinc coating will likely be gone from the original weld sites on a vehicle flange, but refrain from removing the coating on the replacement panel.

- should generally be kept intact on inserts used for making GMA (MIG) butt joints. When making an insert, choose the E-coated metal when possible, which will also include an intact zinc coating. Remove the E-coat only where the weld will be made.

Volvo S40

The grinding process creates heat, forming moisture when the metal cools, which is a corrosion promoter.

Heat is a promoter of corrosion, whether applied during the grinding process, when GMA (MIG) welding, or directly with a heat source. When heat is applied, the metal gets hot and then cools. This forms condensation, or moisture, which accelerates corrosion.

The corrosion-acceleration process worsens with every heat application.

Notice how the coatings on the backside of the panel have been burned away from the stud welding process.

Not remembering the backside is a way that technicians may be causing corrosion without knowing it. Backsides of a repair may not be visible, but if not addressed, corrosion will form and eventually will be visible.

Backsides of repairs are important because most processes done on the front side also affect the backside. Examples include:

- GMA (MIG) welds along flanges or seams. The heat-effect of a GMA (MIG) weld removes both the E-coat and zinc coating on the backside, leaving the area open to corrosion.
- areas where picks, hammers, and dollies were used.
- anchor clamp sites.

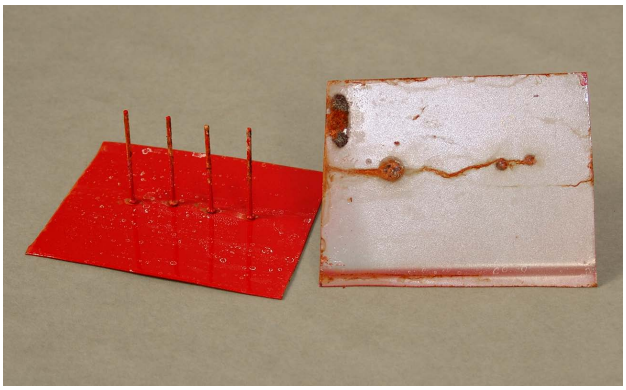
Refer to Module 1, “Demonstration: Untreated Backside” in the presentation for an example of an untreated backside sample.

Honda Pilot

Paintless dent repair requires pushing a dent out from the backside, which may disturb the backside coatings.

Besides the examples already mentioned, the backside of a paintless dent repair is a commonly missed backside area. Paintless dent repair:

- as the name implies, is a process of removing shallow dents while not disturbing the integrity of the finish. Using plastic-tipped pick tools, the technician gently pushes the dent out from the backside with a lever-type action. If the repair is done right, no panel refinishing is required.
- requires backside access, and that access must be existing.
- may cause an issue with the backside even if the front side does not require refinishing. During this process, it is possible that the E-coat or wax-based coating on the backside of the panel was removed from the repeated scratching of the dent tool tips, even though the tips may be protected with plastic. Therefore, corrosion protection must be restored to ensure the durability of the repair. This is recommended for most PDR repairs, as it is difficult to see if the corrosion protection was removed. It is better to assume that the finish has been scratched and apply corrosion protection to the panel backside.



This coupon example shows the issue with stud weld sites. Even though the stud tab is removed from the front side, corrosion can still form on the backside and must be addressed.

Another common example where there could be a backside corrosion problem is a stud weld site. The stud welder tab is pulled off, the stud mark evidence

is removed from the front side, but the backside is ignored. These must be treated similar to the site of a weld joint. This process may even leave a hole where the stud weld was pulled off, which should be welded shut.

Honda CR-V

A typical recommendation for treating the backside of a repair is applying anti-corrosion compound with a wand through existing holes.

To protect the backside of repairs:

- clean the weld and dent repair backsides, if there is access.
- apply corrosion-resistant primer, if there is access for cleaning. Primers require a clean surface for proper adhesion. Corrosion-resistant primer need only be applied to areas where the E-coat was disturbed.
- apply anti-corrosion compound directly to bare metal if there is no access for cleaning.

Lower hem flanges and pinchwelds are often traps for collecting water and will corrode from the inside if the backside surfaces are not treated during or after repairs.

Lower hem flanges and pinchwelds are areas where problems could occur if corrosion protection is not considered, due to water collecting in these areas. For example:

- the bottom hem flanges in a door panel form pockets that hold moisture and provide a perfect environment for the forming of corrosion from the inside. These areas must be treated after repair with an anti-corrosion compound to prevent formation of a corrosive hot spot.
- lower pinchweld flanges, such as on the bottom of rocker panels, must be protected. Anti-corrosion compounds have creeping capabilities that protect these areas.
- drain holes may get crushed when torquing anchoring clamps. The drain holes are on the bottom of the rocker panel. If left closed, a water pocket and corrosion will form. Pry open these drain holes after straightening.

The simple act of touching bare metal with bare hands will cause corrosion to form, such as seen here on this sample panel that was subjected to a salt spray.

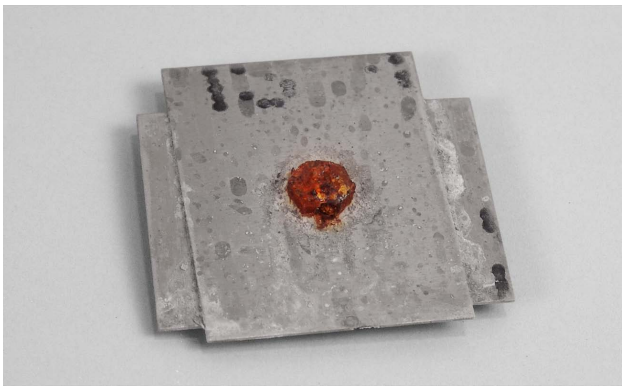
Touching bare metal with bare hands:

- leaves moisture, salt, and other contaminants. This leads to corrosion, even after the metal is coated.
- must be cleaned after touching.
- can be avoided by wearing gloves.

Galvanic corrosion will form whenever two dissimilar metals are left in contact with each other without a coating or hardware isolator between them.

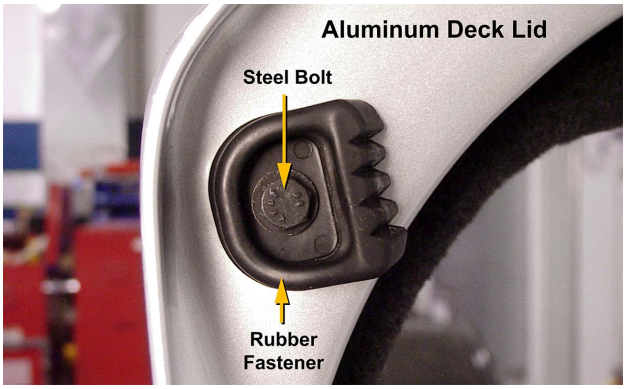
Galvanic corrosion forms when:

- two dissimilar metals come in contact and an electrolyte is added.
- a steel bolt or rivet is used to fasten an aluminum panel and there are no coatings or isolators, such as a special washer, used to separate the dissimilar metals.



Refer to Module 1, “Demonstration: Galvanic Corrosion” in the presentation for an example of a galvanic corrosion sample.

Audi A8

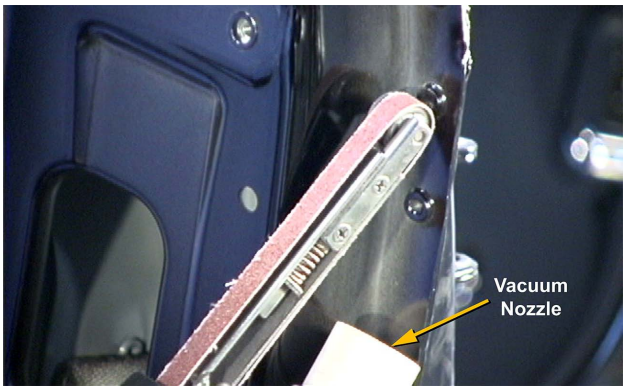


Preventing galvanic corrosion simply means being conscious of what the vehicle maker used to isolate the dissimilar metals, such as this rubber fastener.

To prevent galvanic corrosion:

- duplicate the original fastener installation. This may include the use of special washers, spacers, or other isolators replaced in the proper order as done by the vehicle maker. These are designed to ensure there is no contact between dissimilar metals, such as aluminum and steel or magnesium and steel.
- insulate parts made from dissimilar metals using gaskets, non-metallic washers, and paint coatings. At least one product maker (PPG) has a product in a squeeze tube that can be applied to fasteners and drilled holes to prevent galvanic corrosion. The product, ECK (Electrolysis, Corrosion, Kontrol), is formulated with zinc.
- drill required holes before applying coatings.
- replace coated fasteners if the coating is damaged. Most of these fasteners are one-time use for this reason.

Jaguar XJ



When removing steel rivets that join aluminum panels by grinding or a sander, it is important to clean out steel shavings that might collect on the interior cavity. One way, as shown here, is to vacuum the shavings as they are being made.

Another way to avoid galvanic corrosion is to be aware when removing self-piercing rivets on aluminum-intensive structures. With this situation:

- self-piercing rivets are coated steel.
- removal may include drilling or pressing out or grinding the rivets, which leaves steel shavings inside aluminum rails or other cavities.
- it is advisable to keep the cavity clean by using a vacuum while grinding or vacuuming out as much of the shavings as possible after grinding.
- coat enclosed interiors with anti-corrosion compound.


This course will address corrosion protection in two stages, during repairs in Module 2, and after repairs in Module 3.

This course will approach the restoration of corrosion protection as two stages:

1. During repairs, up through the refinishing process, which will be the subject of Module 2.
2. After repairs, including adding protection to inner cavities, wheelhouses, and underbody areas, which will be the subject of Module 3.

Some of the procedures that will be covered in the next two modules are done in the repair bay and some are done in the refinishing area. Again, corrosion protection must be on all the minds of everyone involved in the repair process.

Module Wrap-Up

Topics discussed in this module included:

- the causes of corrosion.
- steps the OEM takes for corrosion protection.
- how to prevent corrosion during repairs.

Module 2 - Corrosion Protection During Repairs

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Cleaning

Learning objectives for this module include:

- cleaning a part in preparation for corrosion protection coatings.
- preparing an OEM service part, non-OEM replacement part, and a salvage replacement part.
- treating joining surfaces.
- applying primer-surfacer, primer-sealer, self-etching primer, and epoxy primer.
- applying seam sealers.
- applying chip-resistant coatings.

Refer to “Video: Part Preparation” in the presentation. A critical step for corrosion prevention during repairs is making sure metal surfaces are clean. This video shows preparation steps for an OEM part, aftermarket part, and a recycled part.

The first step with mechanical cleaning may be grinding welds (left), and may even include spot blasting (right).

Personal Safety

Protect yourself when grinding or sanding by wearing safety glasses or a face shield, leather gloves, and a particulate respirator.

A critical step for corrosion prevention during repairs is ensuring metal surfaces are clean. After straightening and before any joining processes, the existing surfaces and the replacement part surfaces must be cleaned of contaminants. Cleaning is a two-part process, including mechanical cleaning and chemical cleaning.

Mechanical cleaning may include:

- grinding, only to dress GMA (MIG) welds.
- sanding using various grits. The least aggressive approach is best. Start with the finest grit that will do the job, then move to finer grits as recommended.
- sand or media blasting when entire coatings are being removed.

One product maker, PPG, has issued a statement that soda bicarbonate blasting is not a good process for cleaning parts that will be refinished. PPG did surface analysis in areas of adhesion loss, and found that no matter how well the technician cleans the substrate after soda blasting, there always seems to be small areas in the surface with soda residue. This usually causes adhesion issues for the next paint layer. If that does not occur, there are paint defects that occur later on. Sand blasting or media blasting did not have the same effect.

More information on blasting processes can be found in the live I-CAR "Surface Preparation and Masking (REF02)" training course.

Chemical cleaning may include a solvent or waterborne product, both shown here.

Personal Safety

Protect yourself when using chemicals by wearing safety glasses or goggles, nitrile or rubber gloves, and a vapor respirator. Follow the specific product safety data sheet (SDS) for more specific personal protection.

Chemical cleaning may include a:

- waterborne cleaner.
- wax and grease remover. Follow the paint maker's directions for the paint system being used.

When cleaning with either a solvent or waterborne cleaner, wipe it off in one direction before it starts to dry.

To use solvent or waterborne cleaners:

- apply liberally, keeping the surface wet to float the contaminants.
- wipe with a clean cloth in one direction before it starts to dry. This will help ensure that contaminants are carried away with the cloth. No residue must remain, or it will affect the adhesion of the primer coat.
- turn the cloth after each pass.

Reclean if bare metal contacts skin.

Part Preparations

Preparing an OEM replacement part may include lightly sanding the surface with a soft backup pad to remove minor defects.

Replacement parts must be prepared for corrosion protection application before and during the repair process. These steps may vary depending on if the part is an OEM replacement part, non-OEM replacement part, or recycled part.

With an OEM replacement part:

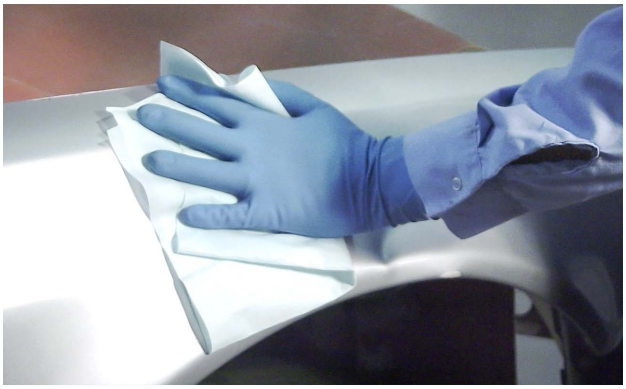
- most have E-coat applied.
- the part should be thoroughly cleaned and dried.
- exposed surfaces that will be topcoated are scuffed. It is not necessary to scuff the backside or underside that is not exposed to direct sunlight or were not originally painted by the vehicle maker.
- inspect for damage. Determine what repairs should be made. To remove minor defects, lightly sand with a dual-action (DA) sander using P400 grit on a soft backup pad, removing as little E-coat as possible.
- primer-sealer is applied. This ensures the color coat and clearcoat have good adhesion and chip resistance. Another benefit is better color coverage.

To test for E-coat, rub the surface with a solvent-soaked cloth and look for coating transfer to the cloth or softening of the coating.

It is a good practice to test replacement parts for E-coat. The coating may be a shipping coating, which is a temporary coating used on some non-OEM parts. A shipping coating may even have been applied to an OEM part that was returned and restocked.

To determine if the coating is E-coat, do a solvent test or rub by:

- rubbing the coating with a cloth soaked in solvent.
- seeing if the coating wipes off or significantly softens. If so, remove all of the coating and apply a corrosion-resistant primer.



Chemical cleaning of aluminum or magnesium parts, such as this aluminum fender, is similar to cleaning steel parts.

The steps for preparing a bare and repaired aluminum or magnesium part are similar to bare steel and repaired steel, at least as far as chemical cleaning is concerned. There are some special considerations for sanding and mechanical tools, including:

- do not use grits coarser than 80. Both aluminum and magnesium scratch very easily.
- oxidation forms quickly on bare aluminum. The rate varies depending on temperature and humidity levels. After being cleaned and left uncoated for an extended period of time, the oxide coating may need to be removed again.
- keep aluminum, magnesium, and steel metal finishing tools and sanding materials separated to avoid galvanic corrosion. Cross contamination from the sanding dust from the different metals will cause galvanic corrosion to occur. This will cause premature metal damage and paint failure.

Inspect a recycled part for excessive film build by using a film thickness gauge on various spots.

When preparing a recycled replacement part:

- wash the part thoroughly with soap and water, rinse, and dry. Follow that by cleaning with wax and grease remover.
- inspect for excessive film build, damage, and corrosion. Repair any damage.
- sand with 600 grit wet or dry by hand or 500 grit with a DA sander and a soft backup pad. Scuff the edges and recesses to remove all gloss.
- apply primer-surfacer, if there are scratches or chips in original finish. Apply primer-sealer to the entire part.

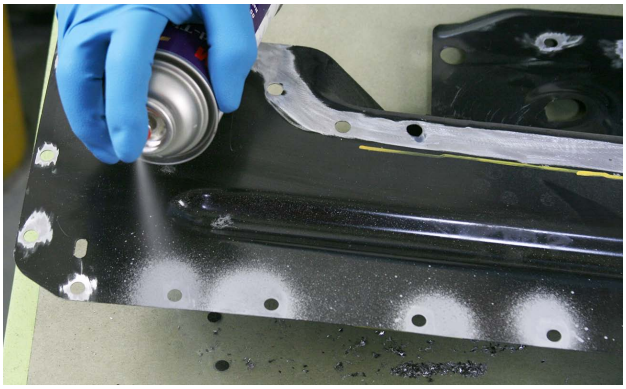
Joining Surfaces

Weld-through primer is available as both an aerosol and brush-on product.

Joining surfaces can be the source of corrosion hot spots if not adequately treated.

After straightening and cleaning weld mating surfaces, a weld-through primer is often applied for corrosion prevention. Weld-through primer:

- is designed to be used for both GMA (MIG) weld and spot weld mating surfaces. This includes butt joint inserts, when the insert is not E-coated.
- is heat-resistant, so it will not burn away during the welding process as much as other coatings would.
- may be zinc or copper based. Claims of 95% zinc or copper content mean that 95% of the coating left after the primer has cured is zinc or copper.
- is available as a spray or brush-on.
- is not a good base for topcoats. Any excess weld-through primer should be cleaned off before applying other coatings.
- may need to be dry to the touch before welding. Some can be welded when the coating is still tacky. For example, 3M weld-through primer needs to be dry before welding. The Sherwin-Williams Shield “thin-film technology” product can be welded while still tacky.



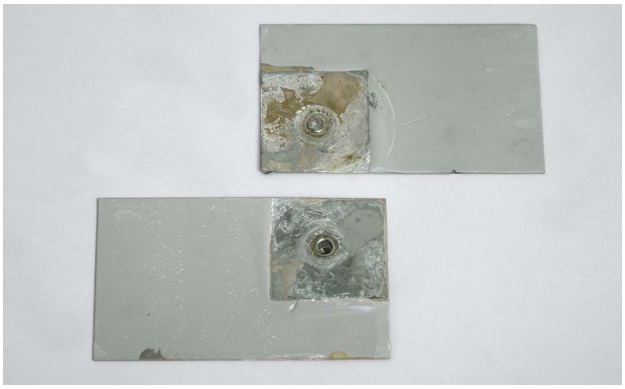
Apply weld-through primer to clean, bare mating surfaces in the weld area.

Weld-through primer:

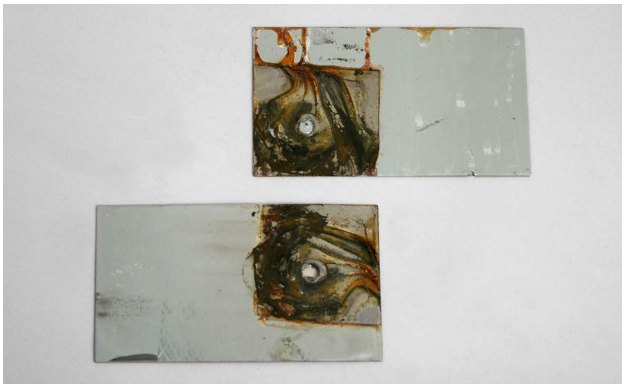
- is applied to clean, bare metal surfaces that cannot be protected by primer or anti-corrosion compound. These areas include flanges and inserts or reinforcements that are flush with the part.
- should not be applied too thick. One thin coat of brush-on or two light coats of aerosol are often recommended. Applying too much will increase resistance to the welding process resulting in excess heat and weld spatter.
- should be removed from the weld zone before GMA (MIG) welding.

Welding through weld-through primer may cause porosity in the weld. This requirement may not be clearly stated on the product container or even the product data sheet.

- varies by the amount that burns away when a GMA (MIG) weld is made.



Refer to Module 2, "Demonstration: Zinc Weld-Through Primer On Mating Surfaces" in the presentation for an example of zinc weld-through primer on mating surfaces.



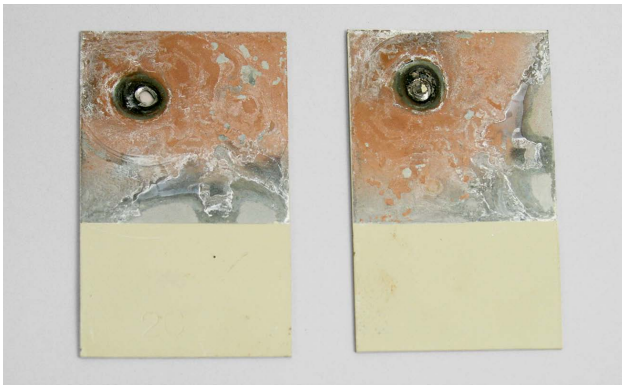
Refer to Module 2, "Demonstration: No Weld-Through Primer On Mating Surfaces" in the presentation for an example of no weld-through primer on mating surfaces.

There is also copper weld-through primer available from some suppliers that, like zinc weld-through primer, still burns away from the weld site when GMA (MIG) welded.

Copper weld-through primer:

- has a higher melting temperature than zinc-based primer, though there is still some that burns away when making a GMA (MIG) weld.
- is available from several product makers, including International Epoxies and Sealers (IES), Kent Industries, and U-POL.

As of the development of this course, copper-based weld-through primer is not recommended by any vehicle maker, though some vehicle makers do not specify zinc-based weld-through primer.



Refer to Module 2, “Demonstration: Copper Weld-Through Primer On Mating Surfaces” in the presentation for an example of copper weld-through primer on mating surfaces.

Refer to “Video: Chrysler On Weld-Through Primer” in the presentation. Not all vehicle makers recommend weld-through primer. Chrysler does not recommend the use of weld-through primer when repairing their vehicles. This is a short video interview with Chrysler Collision Repair Manager Doug Craig on Chryslers decision to not recommend weld-through primer for repairs.

GMC Sierra

Adhesive bond mating surfaces requires removing all coatings, including the zinc, for adhesion. Adhesive is being applied to this pickup boxside.

Adhesive bond mating surfaces:

- usually requires removing all of the coatings, including the zinc, down to bare metal for the best adhesion. Heavy grinding should be avoided, as this would thin the metal and create too much heat.
- require adhesive to be applied to both flanges to cover all the bare metal, as the adhesive contains corrosion inhibitors.
- may also be spot welded, in a process called weld bonding. Weld-through primer is not used on weld-bonded flanges. It is not necessary because of the corrosion inhibitors in the adhesive, and the resulting ring around the spot weld serves as a seal from moisture and air.

More information on adhesively bonded joints and weld bonding can be found in the I-CAR live “Adhesive Bonding (ADH01)” training course.

Refer to Module 2, "Demonstration: Corrosion-Inhibiting Adhesive Sample" in the presentation for an example of a corrosion-inhibiting adhesive sample.

Ford Mustang

Dressing GMA (MIG) weld areas requires grinding flush with the surface.

Personal Safety

Protect yourself when dressing welds by wearing safety glasses or a face shield, leather gloves, and a particulate respirator.

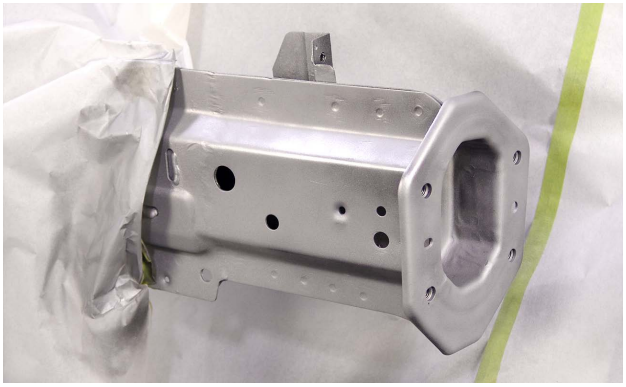
When dressing GMA (MIG) welds on the joint areas:

- grind the weld flush with the surface. Use the smallest disc and finest grit for the size of joint or spot welds.
- ensure no porosity remains, as these cavities in the weld can trap contaminants and be a source for corrosion.
- clean the backsides, as much as access allows.

Primers

Refer to "Video: Epoxy And Self-Etching Primer" in the presentation. This video discusses epoxy primer and self-etching primer.

Chrysler 300



Primer has just been applied to this Chrysler 300 front lower rail extension that was replaced.

Primer coatings:

- include epoxy.

- include self-etching.
- include primer-surfacer / primer-sealer.
- must be applied to a cleaned surface. If there is no access for mechanical and chemical cleaning, primers will not adhere to the surface.

Two-part epoxy primer is available in large containers for mixing, and also as an aerosol.

Epoxy primer:

- may require an etching base, or can go direct to metal. An etching base is a two-step process of applying a metal cleaner and conversion coating, which chemically etches the surface. This process is most often done on restoration projects, rather than in production repair facilities.
- may be recommended under plastic filler by some vehicle makers. Toyota recommends epoxy primer over bare steel before body filler. This is because when fillers are applied over the type of zinc coating process used by Toyota, the filler material will not adhere adequately. Blistering or peeling may result.
- may be one- or two-part. Two-part primers use a catalyst to cure rather than evaporation of solvent. One-part epoxy primers, or epoxy esters, are not prominent in the collision industry.
- includes a two-part aerosol. Two-part aerosols have a limited shelf life once tapped.

Refer to Module 2, "Demonstration: Epoxy Primer Corrosion Sample" in the presentation for an example of an epoxy primer corrosion sample.

Epoxy primer is commonly applied with a spray gun on large surfaces such as this fender.

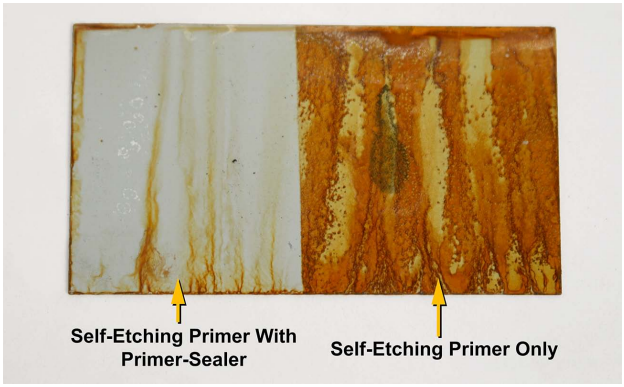
Application of epoxy primer:

- requires cleaning with wax and grease remover.
- requires sanding the repair area and cleaning again. Follow the product maker recommendations for the finest grit. Sanding with too fine of a grit will decrease the quality of primer adhesion.
- is typically done with a spray gun.

Self-etching primer is also available in various forms, including aerosol and a pen applicator.

Self-etching primer:

- contains a phosphoric acid, which neutralizes as it dries. Once the primer has flashed, the acid will not react with other coatings.
- may be one- or two-part.
- may be in the form of a hand-held marker or pen that applies etching primer as easy as stroking a pen.
- when applied, leaves a thin layer that only etches the surface. Self-etching primers do not form a barrier like epoxy primers and would eventually break down. For this reason, self-etching primer must be coated with a primer-surfacer or primer-sealer. Wash primers are a form of self-etching primer that is even thinner when applied.
- if applied too thickly, may inhibit the cure.



Refer to Module 2, "Demonstration: Self-Etching Primer vs. No Sealer Corrosion" in the presentation for an example of a self-etching primer vs. no sealer corrosion sample.

Self-etching primer is being applied to this fender.

When applying self-etching primer:

- start by cleaning the surface, just as with epoxy primers.

- sand the surface and clean again. Follow the product maker recommendations regarding sanding grits. On a spot repair, the usual featheredge area is 3" around the repair area.
- use a spray gun.
- coat with a primer-surfacer or primer-sealer.

Application of self-etching primer must be followed by a coating of primer-surfacer or primer-sealer, such as shown here.

Personal Safety

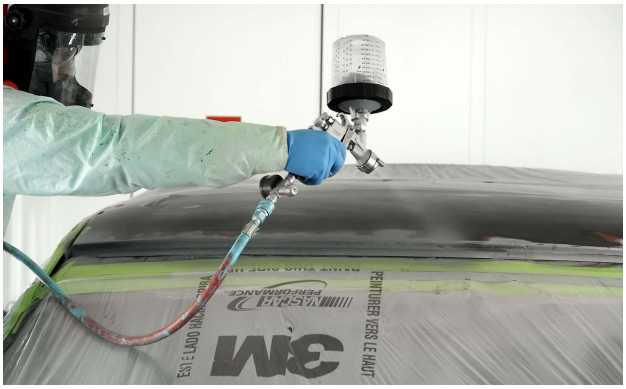
Do not expose eyes or skin to direct UV light. Use UV safety glasses (polycarbonate) available from the lamp manufacturer. UV lamps get very hot and should be kept away from solvent fumes. Avoid burns to the skin.

Urethane primer-surfacer or primer-sealer:

- helps level out the surface for topcoat application.
- is the last step before applying topcoats.
- may be last step for some hidden areas that do not need topcoat.
- may be tinted, which sets a color when using translucent basecoats. A tinted surfacer or sealer will also make chipping of the finish less noticeable in the long term.
- may be direct-to-metal. Sherwin-Williams has a direct-to-metal primer-surfacer, but only for use on a spot repair that is 5" in diameter or smaller. A repair greater than that diameter must first have self-etching primer applied before the primer-surfacer.
- is also available as an aerosol from some product makers, and as an ultraviolet (UV)-cured product from some product makers. PPG has a UV-cured primer-surfacer.

Primer can be applied to interior surfaces only if the surface is cleaned, and one way to do that is by cleaning and priming the interior before enclosing it.

Due to the cleaning requirement for primer coatings, it may be advantageous, even recommended, to apply primer to portions of a panel that will not be accessible after installation. For example, treat the backsides of quarter panels and other areas that may be difficult to access even with wand applicators.



After applying this primer coat, this windshield pinchweld will be masked before applying topcoats.

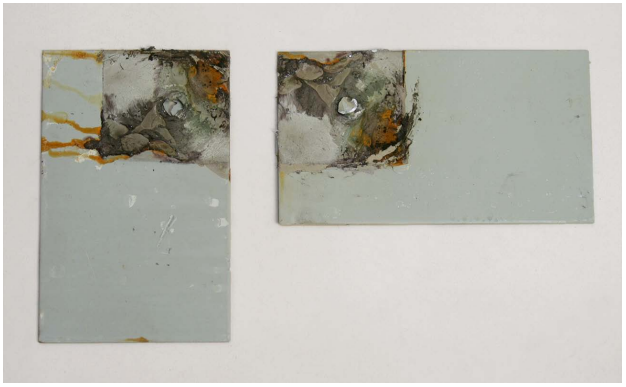
Stationary glass pinchwelds are:

- the flanges where glass is installed.
- masked after applying the primer coat. The exception is Audi, which recommends all topcoats be applied to the glass pinchwelds. At least one vehicle maker, Toyota / Lexus, recommends only epoxy primer be applied to stationary glass pinchwelds, and not self-etching primer. Toyota / Lexus also recommends using epoxy primer on scratches on the pinchweld after removing the adhesive, and not pinchweld primer, which is not a corrosion-inhibiting primer.

More information on stationary glass pinchweld preparation can be found in the live I-CAR "Stationary Glass (GLA02)" training course.

Aerosols

Refer to "Video: Thin-Film Technology" in the presentation. This video discusses thin-film technology weld-through primer and anti-corrosion compound, a completely aerosol system.



Refer to Module 2, "Demonstration: Thin-Film Technology Corrosion Sample" in the presentation for an example of a thin-film technology corrosion sample.

Aerosols are available for most corrosion protection coatings such as self-etching primer and chip-resistant coating.

Aerosols are a simpler way of applying material compared to applying the material with a spray applicator gun. Aerosols are not only available for most corrosion protection materials, but quite common. Aerosol materials:

- are common for small, spot repairs.
- may include wands that can be attached to the spray tip that have 360° applicator tips. The wands may be able to be soaked in solvent and reused.
- are available for weld-through primer, self-etching primer, epoxy primer, anti-corrosion compound, and undercoating.
- may require more product to be applied than when using a spray applicator gun, but this depends on the product. Some aerosols must be thinned to allow them to atomize as an aerosol.

Seam Sealers

Refer to "Video: Application Of Seam Sealers" in the presentation. This video discusses the application of seam sealers.

Honda Accord

Seam sealers are applied to seams, such as this upper rail lower pinchweld.

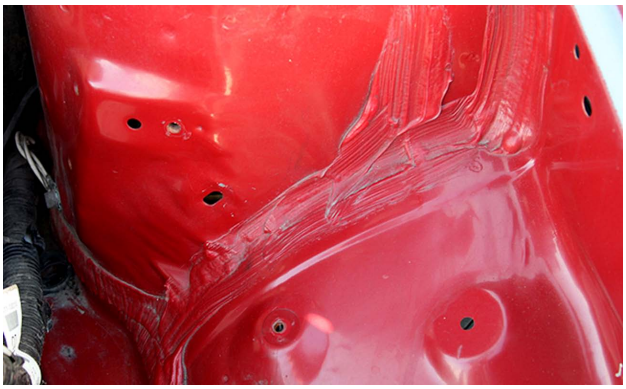
The purpose of seam sealers is to:

- reduce the chances of corrosion in a flange and in joints. The purpose is NOT to fill in gaps or poorly fitted joints, but to complete the seal on the joint.
- seal out moisture and contaminants from these joining areas.
- stop water and air leaks.

- prevent fumes from entering the passenger compartment.
- reduce wind and road noise.

Seam sealers also add to the appearance of the seam.

Toyota Corolla



Even though likely applied by a robot, this seam sealer appears as if it was hand-applied with a brush.

Seam sealers are used, for example:

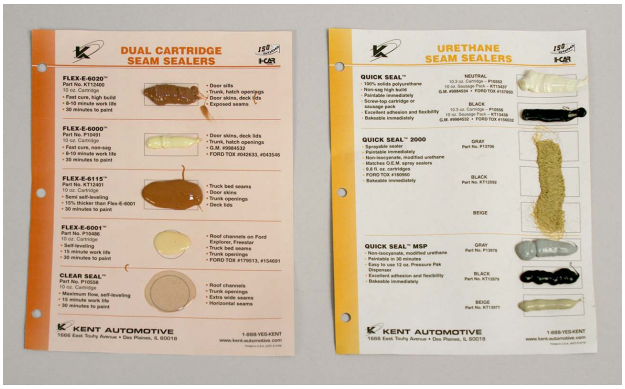
- on a welded seam where leakage could be an issue.
- on closure panel openings.
- around lamps.
- in the engine compartment, including on the cowl, around strut towers, and the apron-to-lower rail joint. Any seam sealer will work for underhood applications. Epoxy-, urethane-, and solvent-based seam sealers are all resistant to gasoline, oil, and other fluids and can take underhood temperatures.
- on floor pans.
- on quarter panels.
- around the fuel filler neck. Solvent-based seam sealers should not be used around the fuel filler neck where there likely is direct exposure to splashed fuel.

Seam sealers are available in many forms, colors, and makeup to allow the best match of the original application.

There are numerous types of seam sealers, including:

- epoxy.
- urethane. Urethane seam sealers are one-part and cure when exposed to moisture and heat. They have no solvents to evaporate, so can be painted immediately and baked without the risk of solvent popping. These sealers should not be tooled with a solvent, which would prevent cross-linking.
- thin-bodied, which are low viscosity and self-leveling.
- heavy-bodied, which have a high viscosity. Heavy-bodied seam sealers are good on vertical joints because they do not run when applied. There are also sealers considered medium-bodied and semi-self-leveling.
- sprayable.

- tape.



Refer to Module 2, "Demonstration: Seam Sealer Samples" in the presentation for an example of seam sealer samples.

This seam sealer has some similar characteristics as any other seam sealer.

All seam sealers have some common characteristics. All seam sealers:

- are paintable, though some are not refinished as they are not seen.
- have good adhesion.
- are flexible.
- are non-shrinking.

All seam sealers have a shelf life, so pay attention to the born date and use-by date to ensure all of the desirable characteristics are still effective.

Different seam sealers also have varying characteristics to best match the original application.

There are varying characteristics of seam sealers as well, including that they may:

- be one- or two-part.
- be non-sagging when first applied.
- have variable cure time. Product makers say to think about seam sealers as a topcoat in regards to the time window after applying primer. In other words, do not apply a seam sealer before the minimum cure time of the primer or after the maximum cure time.
- be colored or clear.
- have an odor, such as solvent-based seam sealer, which should not be used on joints that are open to the passenger compartment. The odors can linger. The odor can also embed in cloth upholstery, carpeting, and headliners. Use a two-part, moisture-cure seam sealer in these areas.

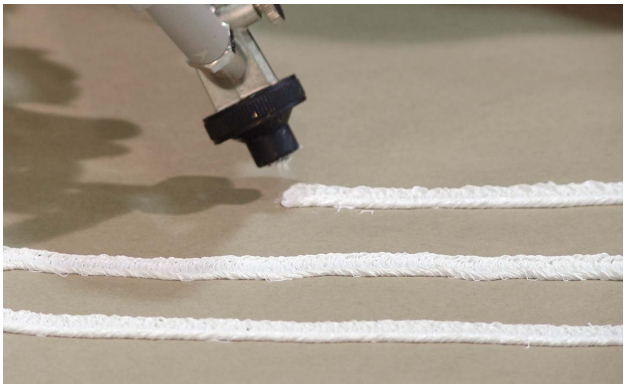
Direct-to-metal seam sealers, available from some product makers, require a clean surface, but not a primer base.

Direct-to-metal seam sealers:

- require no primer or sealer base.
- contain corrosion-inhibitors.
- avoid having to move the vehicle to the spraybooth for priming before applying the seam sealers and then moving back to the spraybooth for applying topcoats.
- require a clean surface. These seam sealers are corrosion-inhibiting, not corrosion-curing. The surface must be similarly prepared as for applying primer and topcoats, including a clean surface.

Examples of product makers with direct-to-metal seam sealers include 3M, International Epoxies and Sealers (IES), and Lord Fusor.

Refer to Module 2, "Demonstration: Direct-To-Metal Seam Sealer Corrosion Sample" in the presentation for an example of a direct-to-metal seam sealer corrosion sample.



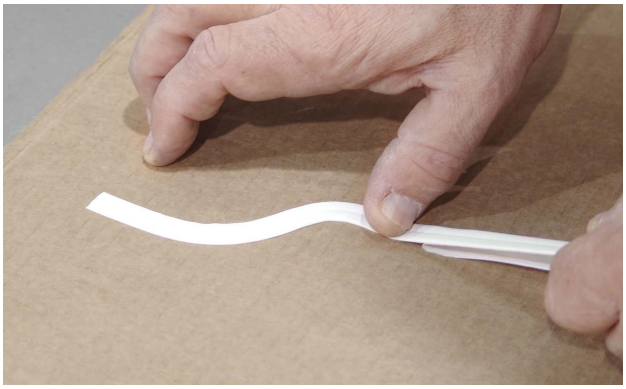
This type of seam sealer is sprayed on to match a specific OEM look.

A sprayable seam sealer:

- has a unique look compared to other seam sealers.
- is typically applied to the underbody, wheelhouses, trunks, and in the engine compartment, but can be applied anywhere to match an OEM application.
- is applied with an air-powered applicator gun.
- has a pattern that varies with two gun settings. The settings control

the amount of pressure applied to the back of the cartridge, and the air atomization / spray pattern. The pattern also varies with the distance the gun is from the surface, and the air pressure going into the gun. Age of the product is also a factor because some sealers become slightly thicker as they age. A final factor would be the technician technique.

Instead of using new product to make test patterns of sprayable seam sealer, ask supplier jobbers if they have outdated product they could give you to experiment with.



A tape seam sealer has similar characteristics as chemical seam sealers, and is used to match an original application that may or may not be tape.

Tape-type seam sealers:

- have a neat appearance.
- have no fumes, since they are a solid tape.
- are often used around closure panel openings, such as around door frames.
- have varying widths.
- are flexible, so they can be routed around irregular surfaces and curves.
- require a properly cleaned surface for the best adhesion.

Some seam sealers that are applied as a putty then baked at the factory, may be most easily duplicated with a tape seam sealer.

Refer to “Video: Matching OEM Application” in the presentation. This video shows how to match the OEM application of seam sealers.

The final test on what type of seam sealer to use is how it matches the OEM application on the other side.

The main goal when selecting and applying seam sealer is to match the OEM application in:

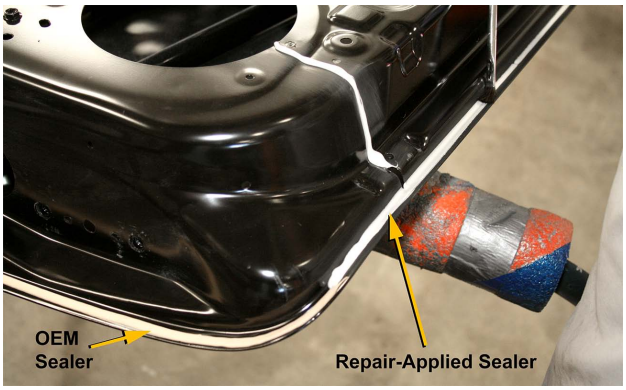
- appearance, including texture and color. Color matters especially for seam sealers that do not have a finish applied.
- performance.
- function.

To match a seam sealer, compare the application side-to-side. Matching may require practice on a test panel.

Vehicle makers may recommend certain brands and have their own part numbers for some seam sealer applications.

Refer to "Video: Adding Seam Sealer To Service Parts" in the presentation. Vehicle makers, including Chrysler and GM, have guidelines on applying seam sealers to service parts.

Toyota Highlander Door

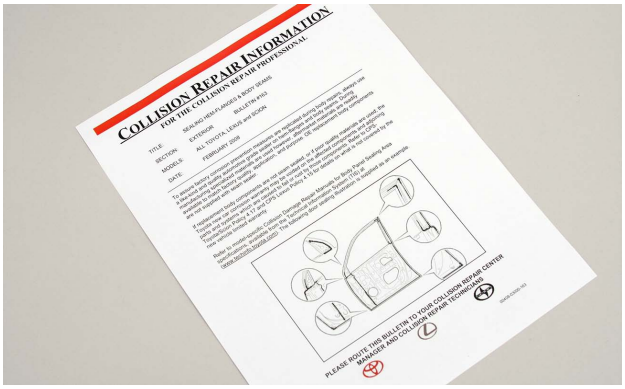


Most vehicle makers require the application of seam sealer to some service parts, such as Toyota on this door panel.

Chrysler and GM are not alone in not applying seam sealer to some service parts. Most vehicle makers apply seam sealer to only a portion of the service parts and many times, seam sealer is not applied at all, especially to closure panels such as service hoods, deck lids, and doors. These service parts:

- are pulled from the assembly line before some or all of the seam sealer is applied.
- must have seam sealer applied at the service facility before installation. The seam sealer must match the other side, and may need to match the portion of seam sealer that is already applied.

Toyota / Lexus has a collision repair information bulletin, or CRIB, number 163, explaining the need to apply seam sealers on these service parts.



Refer to Module 2, "Demonstration: CRIB 163" in the presentation for an example of CRIB 163.

Chip-Resistant Coatings

Refer to "Video: Application Of Chip-Resistant Coating" in the presentation. This video discusses the application of chip-resistant coating.

Chip-resistant coatings available for repairs have various names and colors.

A chip-resistant coating:

- may be called chip guard, gravel guard, etc.
- is usually applied under the topcoat in a repair facility, same as the vehicle maker, though sometimes the material is applied over the topcoat.
- may be textured.

Honda Pilot

This small plastic sheet protector is a chip guard.

Plastic sheets for chip resistance are:

- applied on top of the clearcoat and similarly replaced for repair.
- applied like a decal.
- ordered as a vehicle maker part or cut to fit from an aftermarket kit.

Lincoln MKZ Hybrid

This chip-resistant coating has a distinct line where the coating stops.

Thick applications of chip-resistant coating may be found:

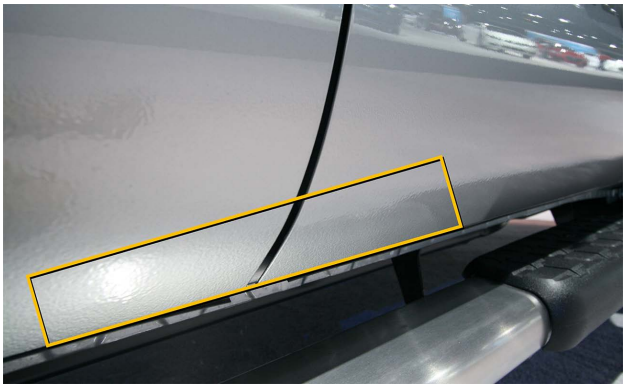
- under the rocker panel.
- at the base of A-pillars.
- at the bottom of doors.
- in the dogleg area.

Other locations that commonly have an extra layer of primer or clearcoat that serve as a form of chip-resistant coating include:

- front of the hood.
- front of the roof.
- on fenders.
- on pickup truck boxsides.

There may also be aftermarket chip-resistant coating applied on the front lower bumper. Vehicle makers do not apply chip-resistant coating to the front lower bumper.

Toyota Tundra



Identifying a chip-resistant coating may be as simple as looking for an exaggerated orange-peel effect, such as on this Toyota Tundra lower door panel.

Chip-resistant coatings may be identified:

- using vehicle maker service information. There are usually line drawings that show where the coatings were applied by the vehicle maker and where they should be applied during the repair.
- by film thickness. A measurement over 12 mils under a rocker panel or on a door panel may indicate the presence of chip-resistant coatings, though excessive film thickness may also be body filler. Look for a consistent thickness.
- visually. Some are textured, and may be visible closeup as a slight variation in the “orange peel” of the finish. The plastic sheets are

easily seen. Some chip-resistant coatings are not visibly apparent.

The material is chosen based on appearance and color, of which there are several to choose from.

When choosing the materials for chip-resistant coatings:

- follow the product or paint maker's recommendation. Vehicle makers usually do not recommend specific brands of chip-resistant coatings.
- color may be a factor. The coatings are usually available as clear, black, or beige. Depending on the basecoat color, one color may be best for hiding.
- it may be based on the substrate coating. Chip-resistant coatings are available for use over acrylic enamel, synthetic enamel, and urethane.

Refer to "Video: GM On Chip-Resistant Coatings" in the presentation. This video features a GM view on application of chip-resistant coating, including the not-so-visible applications.

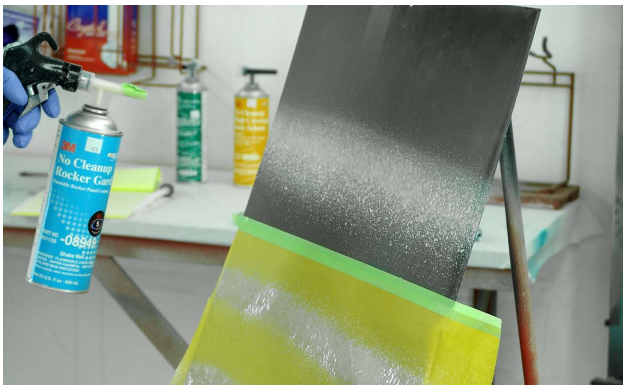
A spray applicator gun can be used for several coatings, such as undercoating.

A spray applicator gun can be used to apply chip-resistant coatings. The coatings are also available as an aerosol. Appearance of the coating may be a factor, and in order to duplicate that appearance:

- variances will affect texture, such as air pressure, distance, number of coats, and speed of application.
- make a test, or let-down panel, if necessary, adding different coats at

each pass until the proper look is achieved.

Refer to “Video: Making A Test Panel” in the presentation. This video shows one procedure for making a test panel before applying chip-resistant coating.



Making a test panel is handy to match a specific coating that needs to be blended.

When making a test panel, take note of:

- the air pressure used. Waterborne and low VOC materials require more pressure to smooth out the texture.
- the distance from the panel. As distance from the surface increases, so does the texture.
- different flash times.
- the number of coats.

Save the test panels for future use when trying to match the same texture.

Toyota Tundra Door

The technician is using the experience gained from making a test panel to blend into the chip-resistant coating on this Toyota Tundra door.

When applying chip-resistant coatings to the vehicle:

- use the experience gained during the test panel process.
- use the proper masking to duplicate the original application, which may also have been tried on the test panel.
- the coating may need to blend into an existing coating. A blending solvent can be used for this purpose.
- sanding may be required to either flatten the application or taper into the same or adjacent panel.

Module Wrap-Up

Topics discussed in this module included:

- cleaning for part preparation.
- preparing an OEM service part, non-OEM replacement part, and a salvage replacement part.
- treating joining surfaces.
- epoxy primer, self-etching primer, primer-surfacer, and primer-sealer.
- seam sealers.
- chip-resistant coatings.

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Module 3 - Corrosion Protection After Repairs

I-CAR®

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Anti-Corrosion Compound

Learning objectives for this module include determining where to apply and how to apply:

- anti-corrosion compound.
- undercoating.

Refer to "Video: Application Of Anti-Corrosion Compound" in the presentation. This video explains the application of anti-corrosion compound.

Anti-corrosion compound is available as an aerosol or for applying with a spray applicator gun.

Anti-corrosion compound material:

- is typically a wax-based coating, though a coating using thin-film technology is not wax-based.
- is called several names by product makers, including anti-rust agent, rust preventer, etc.
- is applied as a fine mist with a wand attached to a special spray gun or an aerosol can.
- has self-healing capabilities.

Refer to Module 3, "Demonstration: Anti-Corrosion Compound Corrosion Sample" in the presentation for an example of an anti-corrosion compound corrosion sample.

Volvo S60

Application of anti-corrosion compound typically involves using a wand to reach inner surfaces.

Personal Safety
Protect yourself when using chemicals by wearing safety glasses or goggles, nitrile or rubber gloves, and a vapor respirator. Follow the specific product safety data sheet (SDS) for more specific personal protection.

Anti-corrosion compound application:

- is usually done with wand attachments for access to inner cavities. Use the access holes and openings recommended by the vehicle maker.
- requires avoiding mechanical parts.
- requires clearing drain holes after the material has set. It may be difficult to avoid the drain holes when applying the material, due to its flow and creep capabilities.

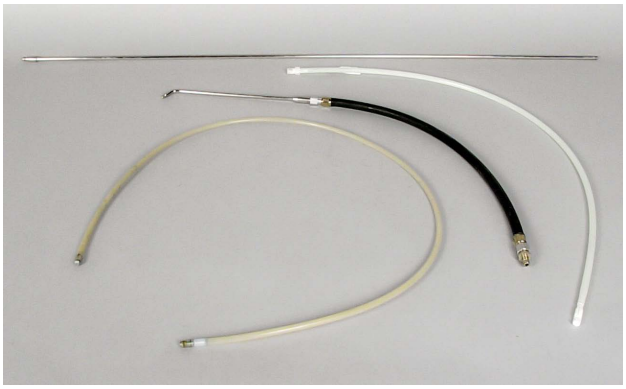
Ford Explorer

The interior of a replaced upper rail is one location for anti-corrosion compound.

Anti-corrosion compound is typically applied inside non-visible areas, such as:

- inside pillars, rocker panels, and rails. Most anti-corrosion compound has creeping capabilities, which allows it to penetrate pinchweld flanges, such as on rail flanges and the lower rocker panel.
- in the bottom perimeter of door shell cavities.
- on the backsides of panel repairs.
- aluminum cavities, not just steel. BMW, for example, states in their service information that after all straightening or welding work on aluminum parts, the cavities affected must be sealed with a cavity protection agent after being painted. Jaguar, in the service information for the all-aluminum XJ, states to treat all interior surfaces that have been disturbed by repairs. This includes all box members, cavities, and door interiors.

Anti-corrosion compound may be recommended over primer, if the surface can be accessed for mechanical and chemical cleaning. Primer adds a layer of protection. Epoxy primer is most recommended. Self-etching primer could also be applied, but it requires a coating of primer-surfacer or primer-sealer over it before applying anti-corrosion compound, whereas epoxy primer is a one-step application.



Spray wands may be flexible or rigid, straight tip or flexed, and different lengths.

Spray wands for applying anti-corrosion compound:

- are available as flexible and rigid.
- come in different lengths.
- include spray heads for a 360° or fan pattern.

It may be difficult to monitor film thickness and coverage, especially with the flexible wands. It is recommended to spray some of the material into a cardboard box to get an understanding of the direction of the wands when spraying. Rotating the wand several times before it is removed helps obtain better coverage.

Undercoating

Refer to “Video: Application Of Undercoating” in the presentation. This video discusses the application of undercoatings.

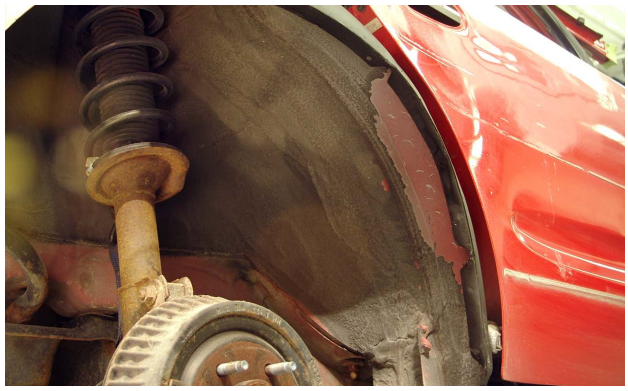
Undercoating material is available as an aerosol or for applying with a spray applicator gun.

Undercoating material:

- is a thick tar- or synthetic rubber-based material.
- is applied to wheelhouse and underbody areas, as recommended by the vehicle maker. The bottom of the fuel tank is another area commonly recommended for undercoating application.
- protects against abrasion from stone chips and other road debris, and corrosion.
- may be solvent- or water-based. Solvent-based undercoating may have some wax to keep the material flexible in cold temperatures.
- can be applied over primer. Some can be applied over bare steel. Check the product maker recommendations.

- has varying thicknesses, colors, and consistencies to match the OEM and aftermarket appearance.

Refer to Module 3, "Demonstration: Undercoating Corrosion Sample" in the presentation for an example of an undercoating corrosion sample.



Undercoating is a thick coating that is resistant to stones and other road splash, such as the coating on this wheelhouse.

Characteristics of undercoating generally include:

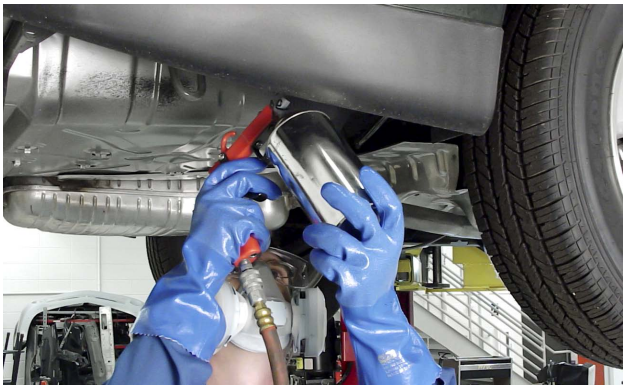
- resistance to road splash.
- resistance to oils and solvents.
- an ability to creep into hard-to-reach areas. Hard-to-reach areas include flanges and under inserts. The material should be sprayed at the correct viscosity to allow it to flow through the spray wand with the proper atomization for thorough coverage.
- remaining flexible as the material ages.
- self-healing. If the material is scratched, some products will flow back into the scratched area.
- serving as a sound deadener.

Lincoln Town Car

This is a special undercoating recommended by Ford Motor Company that is applied to the outside of frame rails, among other areas.

Undercoating is applied:

- using the product maker's spray application equipment.
- as an aerosol for small spot repair areas.



General recommendations from vehicle makers include keeping undercoating away from movable mechanical parts and areas that have high heat, such as exhaust parts.

Vehicle makers are consistent in saying to avoid mechanical parts and high heat areas when applying undercoating, including:

- brake system parts.
- exhaust system and related parts.
- suspension mounting areas.
- emission parts.
- ball joint covers.
- electrical connectors.

Module Wrap-Up

Topics discussed in this module included:

- anti-corrosion compound.
- undercoating.

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Module 4 - Vehicle Maker Recommendations

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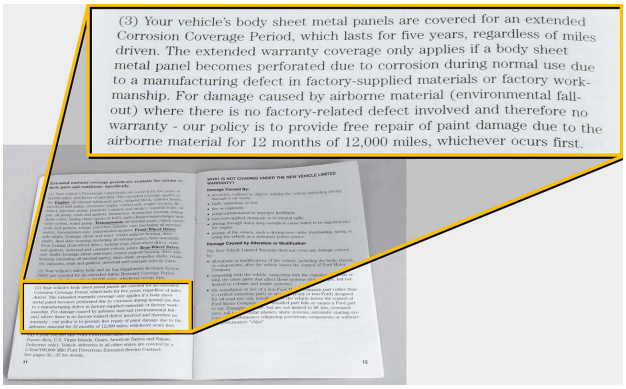
OEM Warranties

Learning objectives for this module include:

- explaining what is covered and not covered in OEM warranties.
- listing the corrosion protection recommendations from different vehicle makers.



OEM corrosion warranties are printed in the owner's manuals.

OEM corrosion warranties may:

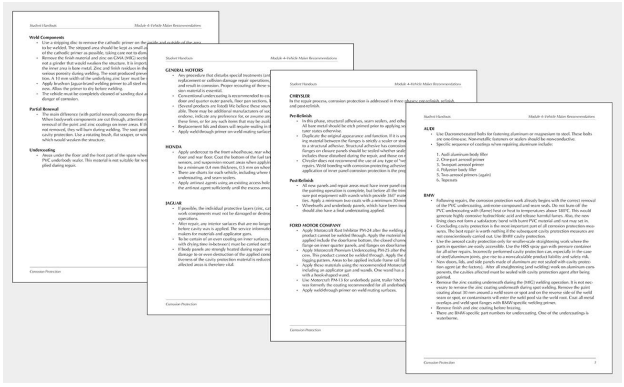
- be up to 12 years and higher. For example, Audi, BMW, Volkswagen, and Volvo have 12-year unlimited corrosion warranties. Porsche has a 42-year unlimited corrosion warranty.
- be unlimited mileage or a set number.
- cover surface corrosion, only rust-through corrosion, or panels repaired under warranty.

OEM warranties generally do not cover surface corrosion on frame rails.

Items OEM warranties may not cover include:

- cosmetic or surface corrosion from stone chips, scratches, hail, or acid rain.
- surface corrosion on the underbody.
- body panels repaired or refinished that are not part of a warranty repair. In order to compensate, some repair facilities may offer their own warranty.

Vehicle Maker-Specific Recommendations

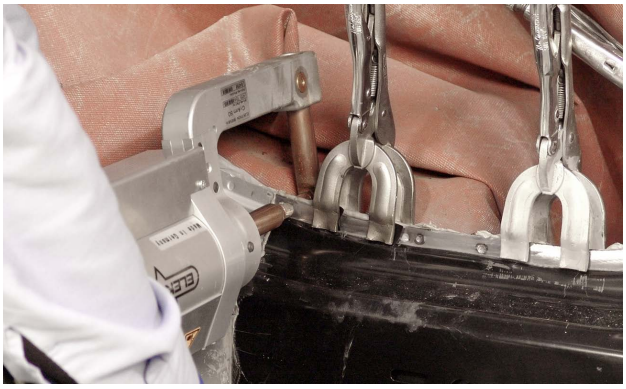


Refer to Module 4, "Activity: Vehicle Maker Recommendations Handout" in

the presentation for an exercise on vehicle maker recommendations.

Refer to “Video: Chrysler Recommendations” in the presentation. This is a video interview on Chrysler's selection of materials for corrosion protection.

Chrysler 300



Among Chrysler recommendations are several body side applications for weld bonding, which is a combination of using structural adhesive and spot welds.

Chrysler Group LLC recommendations include the following:

- Do not use weld-through primer. Chrysler is alone in this recommendation. Chrysler sees no benefit from weld-through primer. These primers pollute the weld and also burn back from the weld zone causing corrosion hot spots. Adequate coverage with anti-corrosion compound provides the highest level of corrosion protection possible when weld bonding cannot be used. No protection on the weld mating surfaces is a concern, but the repair technician has the opportunity during the anti-corrosion compound application to focus on applying materials that will eliminate or reduce the corrosion concern.
- Apply structural adhesive on weld bond areas. These adhesives have corrosion-inhibiting properties.
- If it is unknown whether the original application is an adhesive or sealer, use structural adhesive.

Chrysler specifies to apply undercoating and anti-corrosion compound with a spray applicator gun.

Chrysler Group LLC recommendations also include the following:

- Seal hem flanges on closure panels whether a sealer is

apparent or not. This includes seams disturbed during repairs and on new replacement panels. Either duplicate the existing bead in shape or size, or seal the hem flange in a discrete fashion. Use Mopar product, Fusor 129, or 3M 08308.

- Seal exterior lap joints, visible or not.
- Use a spray applicator gun for applying anti-corrosion compound. Coat inner cavities after refinishing, but before applying all of the trim. Use the specific Mopar product number or 3M Rustfighter. Apply two coats with a minimum 30-minute dry time between coats.

Apply undercoating to wheelhouses and underbody areas involved in the repair process using a spray applicator gun. Use the specified Mopar product or equivalent.

Chrysler collision repair information can be found on the TechAuthorityII website. The TechAuthorityII website is a pay site for service manual information, but the Body Repair Manuals are excluded from that requirement. Anyone may log in at no charge, once they have created a user ID, and access the collision information.

Refer to “Video: Ford Motor Company Recommendations” in the presentation. This video explains Ford Motor Company recommendations for applying anti-corrosion coatings.

Ford Motor Company specifies PM-24 rust inhibitor and PM-25 undercoating.

Ford Motor Company recommendations include the following:

- Use Motorcraft PM-24 rust inhibitor for exposed finished surfaces or after bare metal repairs. PM-24 is available for use with a spray applicator gun, and an aerosol for spot repairs.
- Use Motorcraft PM-25 for undercoating. PM-25 is solvent-based but does contain wax to keep it flexible in cold weather.

Apply the material in light mist coats.

- Use Motorcraft PM-13 for underbody paint on trailer hitches, suspension arms, etc. PM-13 was formerly the coating recommended for all underbody areas.
- Use the recommended Motorcraft application equipment, including an applicator gun and wands. One wand has a 360° tip and another is short with a hook-shaped wand.

Refer to "Video: GM Recommendations" in the presentation. This video explains GM recommendations for applying anti-corrosion coatings.

Chevrolet Sonic

General Motors lists specific paint systems for repairs to their products, such as this 2011 Chevrolet Sonic.

General Motors Company recommendations include using specific primers and paint systems listed on their free website. Go to www.genuinegmparts.com, accept the Terms of Use, pull down the "Collision Repair" tab and choose "Technical Info", then "Anti-Corrosion Treatment and Repair." Choose the "Paint Shop" tab for recommended paint systems.

Honda Accord Crosstour

Honda / Acura recommends referencing charts on their website for corrosion protection repairs to their products such as the Honda Accord Crosstour.

Honda / Acura recommendations include the following:

- Apply undercoating to a minimum 0.4 mm thickness, and 0.5 mm on wheelhouses and the lower dash.
- Follow the charts for each vehicle on the Honda website, including where to apply anti-corrosion compound, undercoating, and seam sealers.
- There are no specific undercoating or anti-corrosion materials recommended. Follow the material maker recommendations for application.

Mitsubishi Eclipse

Mitsubishi recommends brush-on weld-through primer, but only for spot welding on their products, such as the Eclipse.

Mitsubishi recommendations include the following:

- Use brush-on weld-through primer. Mitsubishi refers to weld-through primer as a brush-on electroconductive spot sealer. There are no specific product recommendations, only to use a brush-on type. It is recommended to allow the primer to dry to the touch, about 30 minutes, before spot welding.
- There are no guidelines for using weld-through primer when GMA (MIG) welding.
- Undercoating film thickness should be at least 0.75 mm (.0.03").

Infiniti M

Nissan / Infiniti wants technicians to apply a Bitumen wax after applying undercoating to vehicles, such as the Infiniti M.

Nissan / Infiniti recommendations include the following:

- Confine finish removal during welding to a minimum.
- There are no specific product recommendations for anti-corrosion compound, though it is suggested to look for one which will penetrate after application and has a long shelf life.
- Apply Bitumen wax after undercoating. Again, no specific recommendations for undercoating products, but select one which is rust-resistant, soundproof, vibration-proof,

shock-resistant, adhesive, and durable.

Toyota Tundra

Toyota / Lexus prefers epoxy primer instead of self-etching primer on general areas, and epoxy primer instead of pinchweld primer on stationary glass pinchwelds.

Toyota / Lexus recommendations include the following:

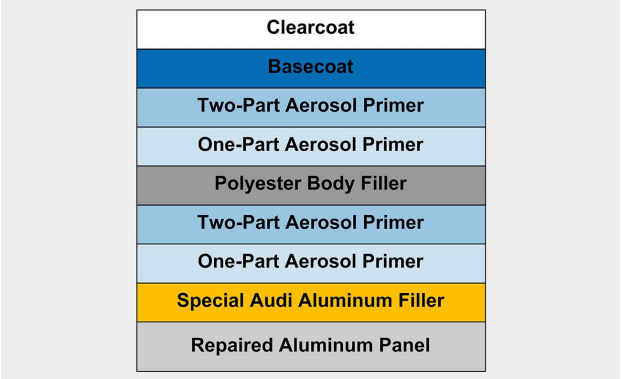
- Apply epoxy primer before body filler. One of the reasons for this is because of the process used to apply a zinc coating on panels, called “Excelite.” This process is two layers of zinc plus a layer of iron. The iron coating is designed to help finish adhesion. Epoxy primer is the only primer that provides the same protection.
- Fill scratches on a stationary glass pinchweld with epoxy primer, not pinchweld primer. Pinchweld primer does not provide proper corrosion protection on the bare metal.
- The first choice for sectioning joints is epoxy primer, not self-etching primer.

Audi TT

When repairing Audi vehicles, such as the rear of this TT, specially coated bolts are used for fastening aluminum or magnesium to steel.

Audi recommendations include the following:

- Use Dacromet-coated bolts for fastening aluminum or magnesium to steel. These bolts are one-time-use.
- Non-metallic fasteners or sealers should be non-conductive.



Audi recommends this series of coatings after repairs to an aluminum panel.

Audi has a specific sequence of coatings when repairing aluminum. This includes the following:

1. Audi aluminum body filler
2. One-part aerosol primer
3. Two-part aerosol primer
4. Polyester body filler
5. Two aerosol primers (again)
6. Topcoats

BMW 5 Series Gran Turismo

BMW considers cavity protection with anti-corrosion compound the most important step.

BMW recommendations include the following:

- There are BMW-specific part numbers for the recommended weld-through primer, anti-corrosion compound or cavity protection, and undercoating. One of the recommended undercoatings is waterborne.
- Cavity protection is the most important of all corrosion protection applied by the repair facility. Apply anti-corrosion compound, called “cavity spray,” in cavities after refinishing. Minor cavity spray is aerosol, and major cavity spray is applied with a spray applicator gun. The specified spray applicator gun also has a BMW part number.

BMW 128i

BMW recommends removing the zinc coating when doing GMA (MIG) welds.

BMW recommendations also include the following:

- Remove the finish coatings about 30 mm around a weld seam or spot, and on the reverse side of the weld seam or spot. If not, contaminants will enter the weld pool via the root of the weld seam.
- Remove the zinc coating for GMA (MIG) welds, and coat all metal overlaps and weld spot flanges with weld-through primer.
- Remove the finish and zinc coating before brazing.
- Do not burn off PVC undercoating, which would generate hydrochloric acid and harmful fumes. Also, a new

coating will not form a satisfactory bond with burnt PVC material.

BMW X5 Diesel

BMW is among some vehicle makers that do not apply anti-corrosion compounds inside aluminum cavities, but recommend it be applied after repairs.

Considerations for BMW aluminum panels include:

- new aluminum doors, deck lids, and side panels are not sealed with anti-corrosion compound or cavity protection.
- cavities, seams, and folds formed from new parts must be treated with anti-corrosion compound after repairs, after refinishing.

Jaguar XJ

Jaguar has a specific list of recommended product makers for corrosion protection materials used on their vehicles, such as the aluminum-intensive XJ.

Jaguar recommendations include the following:

- The service information has a list of recommended product makers for materials and applicator guns.
- There are listed methods to avoid galvanic corrosion on aluminum bodies.

Jaguar XJ

Jaguar recommends priming internal areas before applying anti-corrosion compound.

Jaguar recommendations also include the following:

- Apply brush-on Jaguar-brand weld-through primer to steel mating flanges and allow it to dry. This recommendation is for spot welding only.
- Remove the finish material and zinc on GMA (MIG) sectioning joints with a wire brush, not a grinder, which would weaken the structure. It is important for the weld quality that the inner area is bare metal. Zinc and finish residues in the weld area burn and cause serious porosity during welding. The soot produced prevents satisfactory cavity protection. A 10 mm width of the underlying zinc layer must be removed along the weld line.
- Prime internal areas before applying anti-corrosion compound. Treat all interior surfaces which have been disturbed by repairs, whether they were treated with anti-corrosion compound during production or not. This includes all box members, cavities, and door interiors.

Porsche Panamera

Among Porsche's instructions is refinishing interiors to the exterior color before welding.

Porsche prefers "instructions" rather than "recommendations." Those instructions include the following:

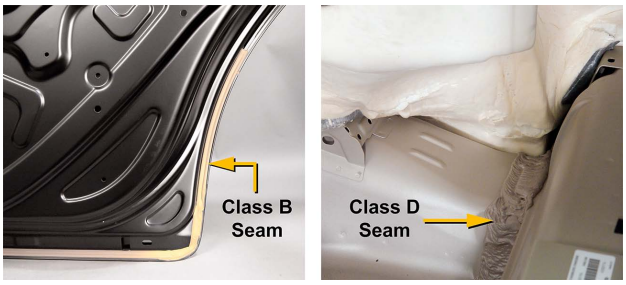
- Apply weld-through primer, called "zinc dust paint" in the service information, on the mating flanges. There is no specific brand.
- Apply two-part primer to bare metal areas.
- Refinish interiors to the exterior color before welding.
- Apply undercoating in different thicknesses by area, identified in the service information. The brands of specific undercoating and chip-resistant coating recommended are listed in the service information. The "gravel guard" undercoating is the same material as is used for some chip-resistant coating applications. Exterior underbody surfaces should have undercoating installed only to primed surfaces.

Volkswagen Touareg Hybrid

Specific undercoating recommended for Volkswagen vehicles includes a wax-based product.

Volkswagen recommendations include the following:

- Apply VW weld-through primer, an aerosol, to both mating flanges.
- Use zinc packing for hinges, etc. Zinc packing is supplied in bags and is used for doors, the tailgate, and hood hinges.
- Apply anti-corrosion compound as directed, which includes a brown sealant and a preservation wax.
- Apply undercoating as directed. The specified undercoating material includes long term, black stone impact, and a wax-based product.



Volvo classifies the different seams for a better guide on which seam sealer to use during repair.

Volvo recommendations include the following:

- Apply brush-on Volvo-brand weld-through primer on weld mating surfaces.
- Use a special spray gun for anti-corrosion compound or cavity wax.
- Seams are classified as A, B, and D. “A” class seams are most visible and include outer panels such as the roof. “B” class seams are less visible and usually apply to door panel seams. “D” class seams are not visible, where appearance is not a factor, but must be liberally applied for a good seam.

Volvo has their own part numbers and recommendations for seam sealers, including their own spray sealer, stone chip protection with a Volvo spray applicator gun, and aerosol rustproofing agents.

Module Wrap-Up

Topics discussed in this module included:

- what is covered and not covered in OEM warranties.
- corrosion protection recommendations from different vehicle makers.