# 2015 Ford F-150 Structural Repair Training Course (FOR06)

Textbook

Version: 16.2



FOR06-STMAN1-E

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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.

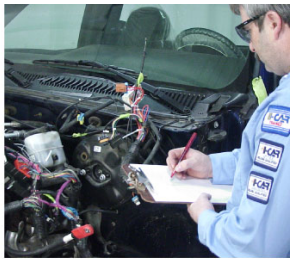
To reduce liability:

- 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.

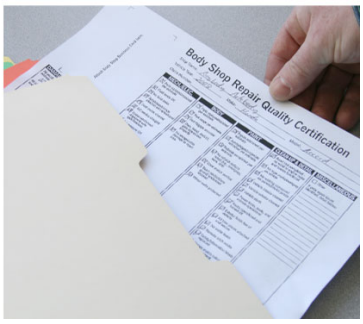
Liability insurance that covers the repair facility may not always cover all damages. For example:

- 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 - Introduction To Ford

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## Introduction To The F-150

Learning objectives for this module include:

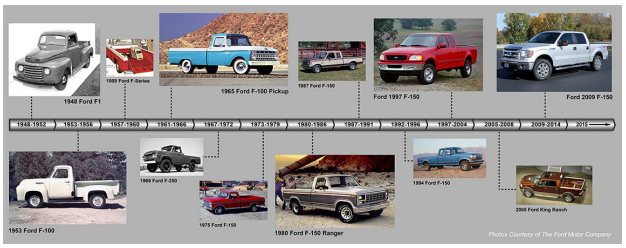
- describing how vehicle weight has changed through different models.
- explaining how Ford is working to meet Corporate Average Fuel Economy (CAFE) standards.
- identifying when the F-Series trucks were introduced.
- discussing the introduction of the F-150.
- identifying where to find Ford service repair information.


*The F1 is what eventually became the F-150.*

The F-Series is a full-size pickup truck from Ford Motor Company that has been sold for over six decades. The most popular of the F-Series is the F-150.

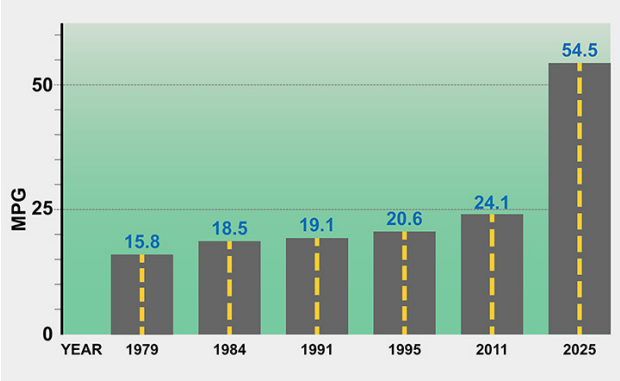
During the post-World War II era, smaller Canadian rural communities had access to either a Ford dealer or a Lincoln-Mercury-Meteor dealer, but not both. A Mercury-badged version of the Ford F-100 was sold at Lincoln-Mercury-Meteor dealers from 1948 - 1968.

Other than grilles, trim, and badging, these trucks were identical to their Ford counterparts.




Although the F-Series trucks were not the first trucks built by Ford, there have been 13 generations of the F-Series trucks. These generations began in 1948:

- First generation (1948 - 1952)
- Second generation (1953 - 1956)
- Third generation (1957 - 1960)
- Fourth generation (1961 - 1966)
- Fifth generation (1967 - 1972)
- Sixth generation (1973 - 1979)
- Seventh generation (1980 - 1986)
- Eighth generation (1987 - 1991)
- Ninth generation (1992 - 1996)
- Tenth generation (1997 - 2004)
- Eleventh generation (2005 - 2008)
- Twelfth generation (2009 - 2014)
- Thirteenth generation (2015 - current)




*Due to government mandates,the CAFE standards will be 54.5 MPG by 2025.*

To look at the challenges vehicle makers have faced, notice how Corporate Average Fuel Economy (CAFE) standards have remained fairly stagnant for about a 20-year span. Listed here are the average CAFE vehicle requirements.

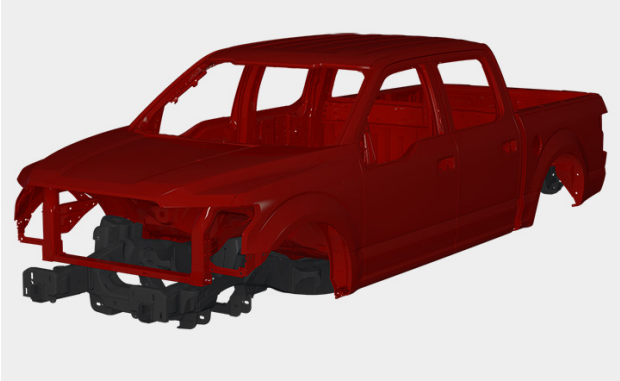
- 1979, 15.8 mpg
- 1984, 18.5 mpg
- 1991, 19.1 mpg
- 1995, 20.6 mpg
- 2011, 24.1 mpg
- 2025, 54.5 mpg

*Customer conveniences all add to the weight of a vehicle.*

As vehicles, technology, and customer conveniences evolve, vehicles have become heavier. To combat weight gain, vehicle makers have begun using alternative materials to steel. These may include plastics, composites, and aluminum. Some of the items that contribute to weight gain include:

- lighting.
- telematics.
- radio.
- DVD.
- navigation.
- acoustics.
- ride and handling.
- trim.
- computers.
- safety equipment.
- emissions.

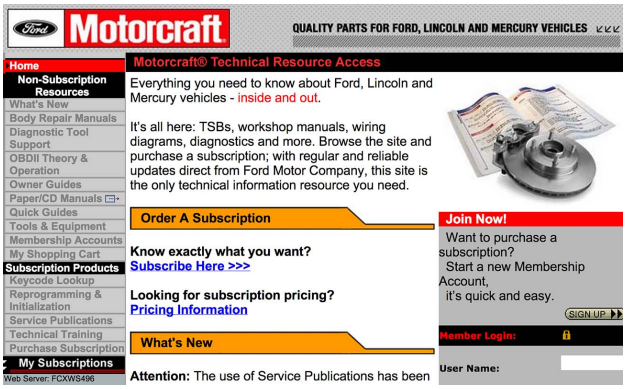

To fill the gap between the F-100 and F-250 the F-150 offically debuted in 1973.



*An all-aluminum cab and box helps reduce weight and increase fuel economy.*

As vehicle options increase, and fuel mileage requirements increase, the overall weight of the vehicle must be reduced. To take steps in reducing the vehicle weight, some of the steps Ford is taking include using:

- more efficient engines.
- a "high-strength military grade aluminum alloy" unitized body structure.
- a "high-strength military grade aluminum alloy" truck bed.
- a lighter but stronger steel frame.




*Ford repair information is located on the Motorcraft Service website.*

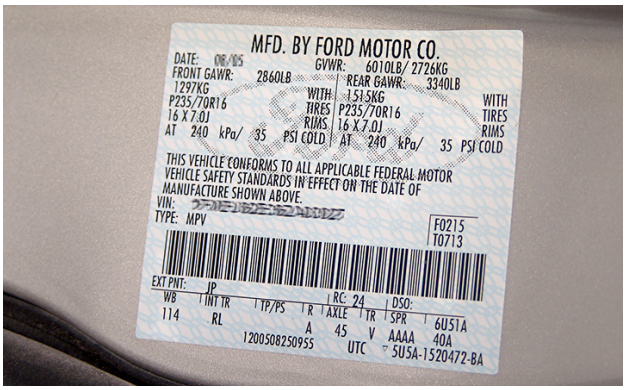
There are two avenues to access Ford technical information. Ford dealers have access to technical information through the Professional Technician Society website, fordtechservice.com. Independent repair facilities can access Ford information at motorcraftservice.com.

This information will contain all of the latest recommended and approved procedures and materials for a complete and safe repair. Recalls and field service sctions (FSAs) can also be found on the Ford online service information site. Access to the Ford service information is available through flexible subscription options.

While Ford can only support Ford-recommended repair procedures, repair information can also be located through the I-CAR  Repairability Technical Support (RTS) i-car.com/RTS. The RTS will bring the collision repair industry together to create a single, unbiased source for technical information and support that every collision repair professional can rely on for assistance in performing complete, safe, and quality repairs. In service of this beneficial industry initiative, I-CAR will:

- act as a “linking pin” between the industry and OEMs to identify gaps and provide clarifications in repair procedures.
- continue to gather subject matter experts at repairability summits to discuss emerging technologies and identify new repair best practices.

- incorporate industry feedback from new technical Industry Segment Advisory Councils (ISAC) representing the OEM and tool and equipment segments to continually enhance the relevance and comprehensiveness of RTS over time.




*All critical vehicle information and codes can be found on the vehicle certification label.*

The vehicle certification label can be found on the driver side door or pillar. Information from this label will be required when ordering parts. A chart in the Ford technical repair information can be used to determine what each code means. The vehicle certification code includes the:

- vehicle as-built specifications.
- interior and exterior color codes.
- region code.
- wheelbase code.
- tire size and air pressure.
- date of manufacturer.
- radio code.
- powertrain information.
- VIN.

More detailed vehicle certification label information can be found in section 100-01 of the workshop manual.

**Module Wrap Up**

Topics discussed in this module included:

- how the vehicle weight has changed through different models.
- how Ford is working to meet CAFE standards.
- when the F-Series trucks were introduced.
- the introduction of the F-150.
- where to find service repair information for Ford.

# Module 2 - Aluminum

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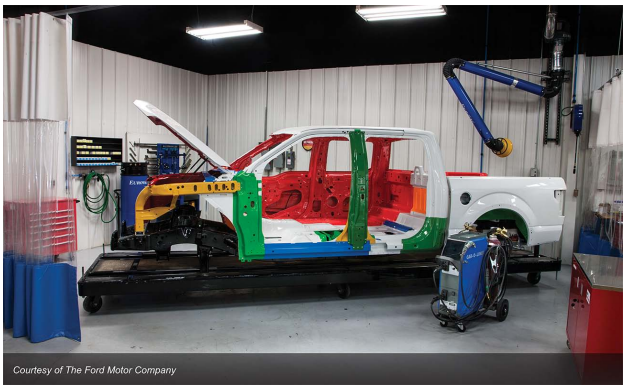
## Aluminum Overview

Learning objectives for this module include:

- explaining safe work practices when working with aluminum.
- identifying the characteristics of a stamping.
- identifying extrusions and their repairability.
- identifying castings and their use.
- identifying heating limits for straightening.
- preventing galvanic corrosion.




*Dedicated aluminum repair areas are designed to protect an aluminum vehicle during repairs.*

When working on or around aluminum vehicles, some special safety considerations must be observed.

### Separate Work Area

Some vehicle makers require that aluminum repair work be done in a designated repair area. An area designated for aluminum repair should be kept free of contaminats with a curtain or in a separate area to prevent steel contamination.

### Dedicated Tools

Some vehicle makers require separate hand tools for working on aluminum. This is to reduce the chance of contaminating the aluminum with steel particles. If dedicated tools are not being used, ensure the tools are cleaned properly to remove any aluminum or steel debris.

### Compressed Air

Do not use compressed air to remove dust that may contain aluminum particles. Aluminum dust will remain suspended in the air longer than steel and will settle throughout the repair facility, causing contamination problems.

### Cutting Tools And Abrasives

Dedicated cutting tools and abrasives for aluminum must also be used. Using a saw blade interchangeably between a steel and aluminum part may cause cross-contamination. When cutting aluminum, there are lubricants that can be used to reduce heat in the area being cut and also increase cutting efficiency.

Some abrasive materials, like cutting and grinding discs, are marked for aluminum only. The grinding discs that are designated for aluminum do not clog like grinding discs that are made for steel.

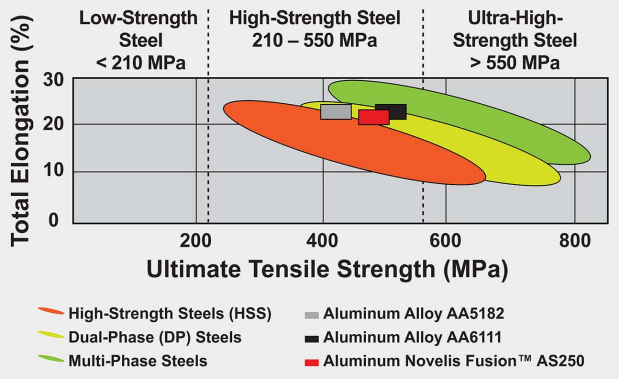
**Dust / Ventilation**

**Warning: Aluminum dust in the correct concentration is explosive if it comes in contact with a spark. Along with aluminum dust being an explosive material, the dust is also a nonhazardous irritant to the eyes, nose, throat, and lungs. It is important to have adequate ventilation to remove the aluminum particles from the air in the work area. If a vacuum is used to clean up aluminum dust, it must have a sparkless motor. Using a typical vacuum can cause an explosion risk.**

When comparing aluminum to steel:

- bare aluminum is more corrosion resistant.
- aluminum scratches are self healing. This occurs from the formation of aluminum oxide over bare aluminum.
- aluminum is lighter. When aluminum is used for the structure of a vehicle, vehicle makers can typically reduce the weight by 30%. When compared to steel used on similar parts, aluminum will be about 1 1/2 times thicker.

According to the Aluminum Association, the average life cycle of a beverage can is 60 days. That is 60 days from when the can is set on the shelf for sale, to being recycled, refilled, and available for sale again.




*Aluminum can be designed to be as strong as some popular high-strength steels.*

Aluminum is made up of different alloys. These alloys may be anything from 1000 series to 7000 series. The series of the aluminum depends on what elements are added. Changing the alloying elements affects corrosion resistance, material hardness, and workability.

The use of aluminum alloys can be likened to making a loaf of bread. Three different people can make three different types, white, rye, and wheat, but the end result is a loaf of bread. The type of aluminum is determined by the elements, or ingredients, added.

A global aluminum-producing company, Novelis, has developed a new aluminum called *Fusion*. This aluminum, when made, is poured from the crucible (melting pot) to an ingot form. As the ingots are formed, the outer edges of the aluminum are quickly cooled. When this occurs, the outer edges of the aluminum are stronger than some conventionally made, rolled aluminum sheets. The Novelis Fusion aluminum has a tensile strength rating similar to that of DP500 steel.

Novelis Fusion aluminum is currently being used by some vehicle makers to make:

- fenders.
- vehicle space frames.
- doors.
- roof panels.

Ford uses 6111 and 6022 aluminum alloy in the unitized cab structure and box assembly.

Publication AT 4

Practices for the Repair of Automotive Sheet Aluminum

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*Refer to Module 2, Demonstration: Describe How Aluminum Strength Is Changed for information about a publication on how adding different elements changes the characteristics of aluminum.*

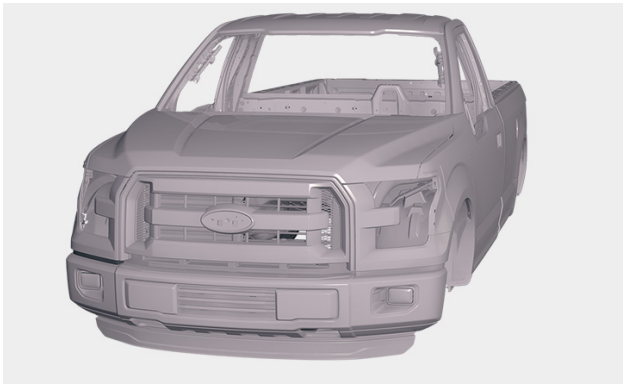
**Aluminum Stampings**

*This bed floor is an aluminum stamped sheet.*

Stamped parts will generally be identified by:

- uniform thickness.
- flanges for attachment.
- stretch marks or gathered areas. In areas of sharp angles, stretch marks or gather areas may be visible.

A stamping is created from a rolled sheet of aluminum that passes across (through) a die.



*The majority of the cab and all of the box are made from stampings.*

The box assembly and unitized cab structure are made primarily of stamped

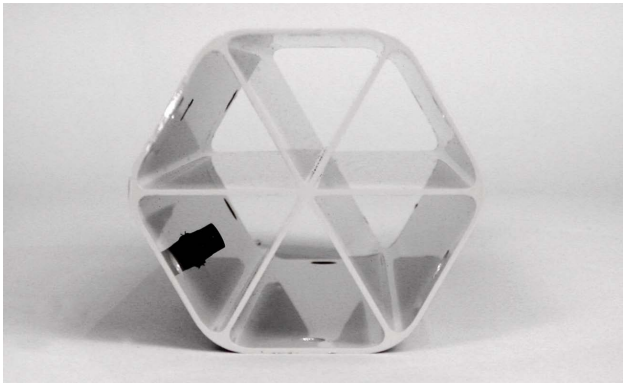
aluminum panels. Even structural parts, such as, the B-pillar, are made from stampings.

*Creases or tears in a panel generally requires panel replacement.*

Though stampings have the most repair options of all aluminum parts, when deciding if a stamping should be straightened, consider:

- if the part should be straightened with the use of heat. Small ("small" being subjective to the repairer) damage generally can be reduced or removed without the use of heat. When removing damage, heat will always make damage removal easier, but the heat may damage the coatings.
- **if heat is being used, Ford limits the use of heat to 425°F**. As long as the heating limits are not exceeded, there is no cumulative time limit for the use of heat.
- the effects of the part stretching. Even though heat will reduce the amount of stretching, aluminum will not react like steel, and oil canning may occur.

**Extrusions**



*This six-cell extrusion is an example of a multi-cell extrusion.*

Extrusions are made by pushing heated, solid aluminum billets through heated dies. It is sometimes pulled as it exits the die if the extrusion must be straight. A simple example of extruding is pushing adhesive out of a tube or cartridge. The adhesive tip serves as the die.

Unique characteristics of extruded parts include:

- no pinchweld.
- there may be an attachment flange on the part which looks like a pinchweld, but is designed to have parts riveted or welded to it.
- complex designs and shapes with seams that are not visible. An extrusion may have a variable thickness cross section. This is done by varying the openings in the die when the part is being extruded. Extrusions are made from a continuous form, either straight or curved. If a part is curved, it may be curved in a post-forming operation. The rocker panel reinforcement

on the 2015 Ford F-150 is an example of a straight extrusion. An example of a curved extrusion on the 2015 F-150 is an A-pillar reinforcement / roof rail.

An extrusion is limited in repairability only by the access it offers to the inside of the part. Extrusions are unique in that there is no specific rule regarding their repairability. Repairability is subject to material thickness, internal webbing design, and vehicle maker guidelines.

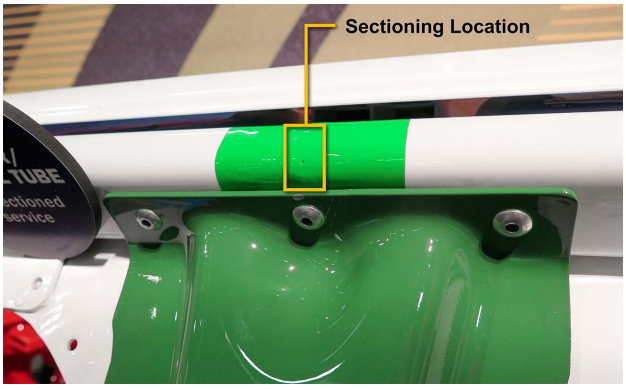
*Shown is a multi-cell extrusion.*

When identifying an extrusion, the characteristics include:

- not having any seams or pinchwelds as it is a one piece part rather than being made from several stampings.
- having cross-sections or webs that may vary in thickness.
- being straight or curved from hydroforming. Hydroformed extrusions may vary in shape and thickness.
- being a single-cell or a multi-cell extrusion. An example of a single-cell extrusion is a piece of tubing. A multi-cell extrusion will have webbing that may vary in shape inside the main extrusion.

The A-pillar reinforcement / roof rail and apron tube are made from extrusions. Extrusions are also used on the rocker panel of the Super Crew.

Some additional extruded structural parts include frame rails and tie bars.




*This is an approved sectioning location of the extruded A-pillar reinforcement / roof rail on the Super Crew.*

**May Crack When Damaged**

When considering what repairs may be possible to an extruded part, keep in mind extrusions may crack when damaged. This occurs because many extrusions have internal webbing that strengthens the part. When straightening is attempted, the extra support from the webbing may also cause the part to crack.

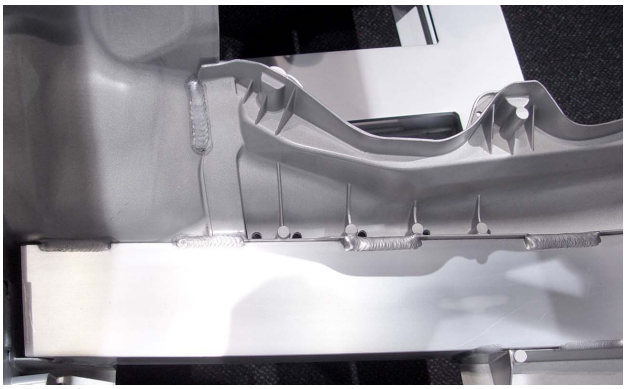
**Limited Repair**

Because of the design of an extrusion, straightening options may be limited

because of little or no access to the backside. If allowed by the vehicle maker. Straightening an extrusion may be done with or without heat. **If heat is being used, do not exceed Ford's recommendations of 425°F**. As long as the heating limits are not exceeded, there is no time limit.

**Sectioning Or Partial Replacement**
The extruded A-pillar reinforcement / roof rail on the 2015 Ford F-150 Super Crew may be sectioned above the B-pillar.

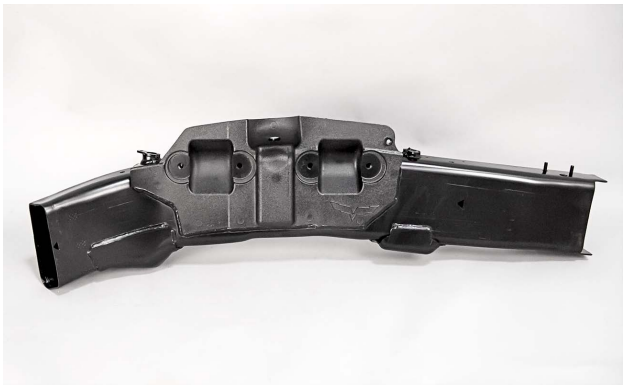
**Castings**



*Various castings are used in the center section of this chassis.*

Aluminum castings:

- are created in a mold that is usually made up of sand or metal to form the casting. This is done by pouring molten aluminum into a mold or injecting molten aluminum into a mold under pressure. The aluminum is allowed to cool and harden, then the cast part is removed from the mold.
- can be made in nearly any shape or wall thickness variations in cross-section and length. It is not uncommon to see a cast part that has irregular shapes and thickness.
- are generally machined to a smooth surface for attachment.
- are generally attached to other parts with GMA (MIG) fillet welds. Castings can also be attached to other parts using bolts or rivet bonding.
- may have a rough-textured surface, such as an orange peel.
- may be hollow or solid. This depends on the function the casting is serving.



*During straightening, this casting developed a crack, which is not repairable.*

Cast aluminum parts are often used for:

- joints where multiple parts come together. On some applications, these are called cast nodes.
- strut towers. It is becoming more common to see strut towers made from aluminum and used on steel vehicles.
- pillars. Though pillars are commonly stamped or extruded,

there are some limited examples of cast pillars.
- suspension parts and mounting locations. This includes control arms, knuckles, and subframes.
- wheels, rear end housings, transmission cases, and engine blocks.

Characteristics of castings include:

- they are not repairable.
- depending where the casting is used, parts may be attached with rivets, bolts, or welds.

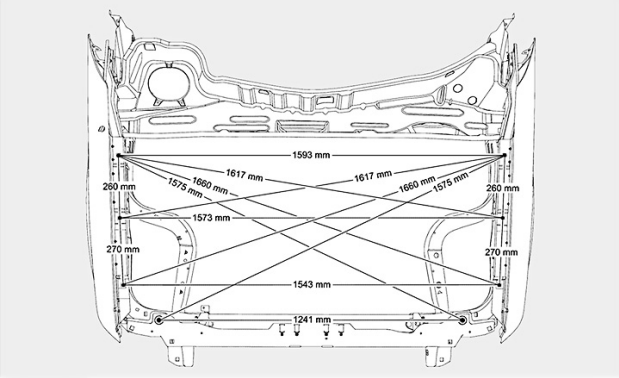
Always follow the vehicle maker's position statements, though damaged threads can often be repaired with a stainless steel thread insert (Heli-coil). Use caution to avoid galvanic corrosion.

On the 2015 F-150, Ford does not use any castings on the cab or box assembly.

Another common casting used may be made of magnesium and is not repairable, like the core support on the 2015 Ford F-150. Magnesium can be mistaken for an aluminum casting. Be aware there is a simple test to verify if a part is magnesium or aluminum.

*Refer to the Video: Identifying Magnesium in the presentation. This video discusses how a casting can be identified as aluminum or magnesium.*

**Aluminum Straightening And Repair**

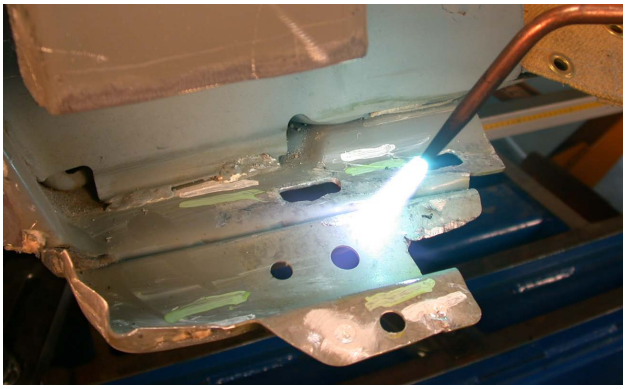



*Underhood measurements can be made to locate damage.*

When measuring an aluminum vehicle, the tools and techniques are the same as those used on steel vehicles. Tools that can be used to measure an aluminum vehicle for damage include a:

- tram bar or tape measure. A tram bar or a tape measure can both be used for making point-to-point measurements. These measurements may be in the

upper, lower, or side areas of a structure.
- mechanical or computerized measuring system. Either mechanical or computerized measuring systems can be used to measure an aluminum structure. If the measuring system uses magnetic target holders, an alternate holding solution will be required.



*Heat-monitoring paint is used when heating aluminum.*

When straightening structural parts, consider if:

- the unitized cab should remain on the frame or be removed. Ford recommends that the aluminum cab and box structure remain on the steel frame during structural straightening operations.
- heat should be used. Ford allows heat to be used for cosmetic and structural straightening as long as the parts being straightened are not kinked.
- the repairs should be made by straightening, or with partial replacement of the part.

**When straightening an aluminum Ford part with heat, do not exceed 425°F.**

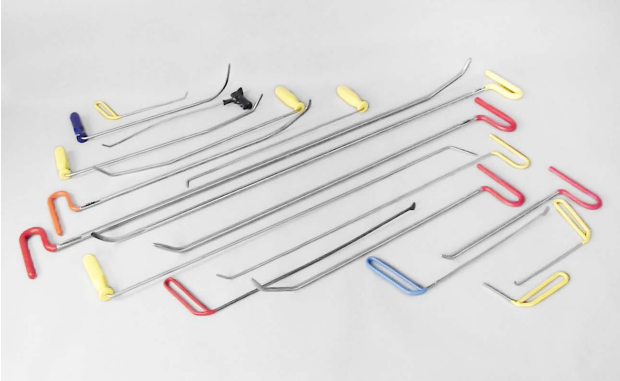
If too much heat is applied to aluminum, the part may become annealed. Annealing is the permanent softening of a part. The part will become softer in the area that was heated. This can compromise passenger protection and the integrity of the part. If a door skin is annealed, it may not be resistant to door dings.

**As a general rule, if any type of aluminum structural part is kinked, cracked, or torn, the part requires replacement.**

**Ford's position regarding damage to a cosmetic aluminum part is that** *"the part may be repaired if it is cracked or torn."*

**Regarding structural parts, Ford recommends that if a structural part is kinked or cracked, replacement is required.**

When repairing aluminum parts or assemblies, it is critical to remember that when adhesives are used they will deteriorate when heated. **Adhesively bonded joints can also be weakened if too much pulling and straightening are done to a part.** Remove and replace any adhesive that was affected by heating.



*PDR tools can be used to remove hard-to-reach damage.*

When straightening aluminum, there are some tips and techniques that can help the straightening to be successful. Some of these include:

- paintless dent repair (PDR). PDR is acceptable for removing damage in hard-to-reach areas. If PDR is used, do not make access locations in the vehicle structure. If backside access is not possible, other means of straightening should be used. After PDR operations are completed, coat the backside of the panel to protect it from corrosion.
- using heat. Heat is a common tool when removing damage from damaged parts. **Each vehicle maker has their own heating limits, but Ford does not want aluminum parts heated above 425°F.**
- conventional straightening using a hammer and dolly. The hammer-off dolly technique is used when possible to avoid stretching and thinning the aluminum.

*Refer to the Video: Emissivity And Heating Aluminum in the presentation. This video discusses how different surface colors will affect the accuracy of temperature readings with a non-contact thermometer.*

*Refer to the Video: Heating Considerations For Aluminum in the presentation. This video discusses some differences when heating aluminum with an induction heater.*

*Thermal paint, thermal stickers, temperature crayons, and a noncontact thermometer are used to monitor heat.*

Heat may be used to temporarily soften and help straighten the aluminum while reducing the possibility of cracking. There is no cumulative time limit when heating aluminum, only temperature ranges.

If heat is being used, do not exceed the vehicle maker's heating recommendations. **Per Ford's rule, temperatures should not exceed 425°F.**

**Temperature Window, Heat Indicators, And Cumulative Times**

When considering the use of heat, it is important to know the temperature window to work within.

When the temperature window is known, the use of heat indicators, such as, thermal paint, thermal stickers, temperature crayons, and noncontact thermometers can be used to monitor heating temperatures.

**Annealing**

If the part is heated beyond the vehicle maker temperature limit, the area being heated may become permanently softened or annealed.

**Emissivity**

If a noncontact thermometer is being used on bare aluminum, emissivity will cause an inaccurate temperature reading. To compensate for this, the surface of the panel needs to be nonreflective. Paint or tape can be applied to the surface being monitored for an accurate reading.

**Color Change, Melting Point, And Heat Transfer**

When heating aluminum, it:

- does not change color before reaching its melting point.
- has a melting point of approximately 1,200°F.
- has a very high rate of heat / thermal transfer. Aluminum will transfer heat efficiently across the panel, about three times faster as compared to steel.


*Always monitor heat so damage does not occur.*

## Effects On Adhesive

Aluminum will transfer heat through a panel three times more efficiently than steel. This thermal efficiency needs to be remembered in situations where heat could damage electronics, trim, adhesives, or coatings. Whenever heat is applied, make sure the areas that contain adhesives do not approach 400°F. At 400°F, adhesive will degrade and not retain its strength.

## Application Methods

When applying heat to aluminum, some of the methods may include using:

- a heat gun. A heat gun may be a better tool to use for applying heat to aluminum because of the controlled heat output.
- a propane or oxyacetylene torch. Though a gas torch is an option for applying heat, gas torches are not commonly approved for heating aluminum. This is because it is very difficult to control the heat output applied to a panel.
- an induction heater, but heating times will be longer compared to steel because aluminum dissipates heat much quicker.
- infrared (IR) heaters for warming larger areas.

## Effects On Thicker Material

Heating thicker aluminum parts may help prevent the parts from cracking compared to straightening without heat.

**According to Ford: Using heat (not exceeding 425°F) to loosen a rivet-bonded panel should only be done when all panels in the joint will be replaced or separated and new adhesive applied.** To follow Ford's recommendations, panels should be separated without heat whenever possible. This will help ensure the adhesive remains structurally sound.


*Dedicated tools for aluminum help prevent cross contamination.*

Some of the tool considerations for cosmetic straightening include:

- avoiding cross contamination from tools that have been used on steel parts. A best practice when working with aluminum is to have dedicated tools for aluminum use only.
- not using hammers with serrated faces. Hammers with serrated faces can thin the material and cause profile imprints from contacting the aluminum.
- polishing the faces of hammers and dollies. Polishing the faces and surfaces of hammers and dollies helps prevent corrosion, softens edges, and removes imperfections.
- rounding the edges of the straightening tools. Doing this helps reduce the chance of scratching the backside of the panels.
- using hardwood mallets and slappers. Oak, ash, and elm are good materials for making mallets and slappers. They are a hard material, but yet flex a bit upon impact.


Position Statement Table of Contents

Please click a link below to go directly to the position statement or scroll down to read.

- Use of New Aftermarket (Imitation) Collision Parts (June 1, 2004)
- Use of Recycled (Salvage) Collision Parts (June 1, 2004)
- Use of New Aftermarket (Imitation) Collision Parts and Air Bag Systems (June 1, 2004)
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- Clearcoat Blending Procedure Not Recommended (October 6, 2009)

*Ford publishes repair position statements to help provide direction for safe vehicle repairs.*

Ford has a straightforward position about repairing cracks in aluminum. If the cracks occur in:

- cosmetic parts, the cracks may be repaired.
- a structural part, the part must be replaced, as the crack must not be repaired.

## Corrosion

*Aluminum corrodes in the presence of steel and moisture.*

Galvanic corrosion occurs when dissimilar metals in contact with each other in the presence of an electrolyte such as water.

To prevent galvanic corrosion:

- seal the area with a protective coating.
- use nonconductive spacers or grommets.
- install protective coating fasteners.
- apply nonconductive adhesive.

**Module Wrap Up**

Topics discussed in this module included:

- safe work practices when working with aluminum.
- the characteristics of a stamping.
- extrusions and their repairability.
- castings and their use.
- what the Ford heating limits are for straightening.
- the prevention of galvanic corrosion.

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# Module 3 - Aluminum Joining Methods

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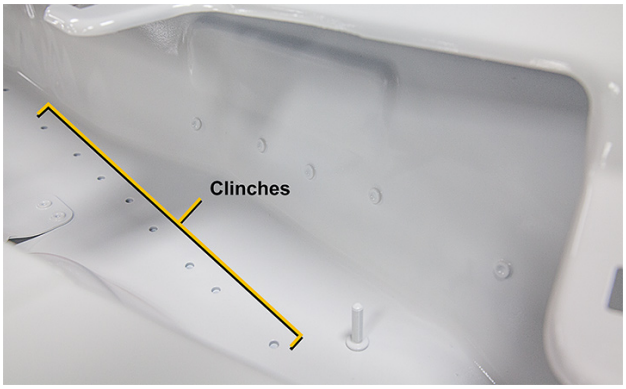
## Clinches

Learning objectives for this module include:

- explaining where a clinch may be used.
- describing the different types of fasteners used with aluminum.
- describing what types of rivets are approved for use on Ford vehicles.
- explaining what is required for replacing a riveted part.
- describing why aluminum flanges are treated differently than steel.
- explaining what is different with welding aluminum versus steel.




*These clinches were made by the vehicle maker on this non-structural part.*

Clinches are made by a cold forming process where two panels are pressed together to make their own fastening system. A die is used to punch an imprint into a panel, and no hole is made. Clinches are not used as a structural attachment method. If a clinch comes loose, a hole is drilled through the clinch. Adhesive and a rivet are used to secure the panels.

## Threaded Fasteners

*These are examples of coated bolts (left), and a flow drill screw (right).*

Generally, threaded fasteners used on aluminum parts have a protective coating. The coating may be green or gray. These coatings are designed to insulate the steel fastener from the aluminum part. By offering an insulating barrier, the chance of galvanic corrosion is reduced.

Because of the coatings on the fasteners, inspection is required following removal to minimize corrosion if reused. Always follow the vehicle maker's recommendations when reusing fasteners.


*A torque wrench is a recommended tool when working with aluminum.*

Threaded fasteners should:

- be installed by hand. By doing this, the chance of cross-threading is reduced. After the fastener has been hand tightened, hand tools should be used to tighten the fastener. When removing a bolt, screw, or nut, air tools should not be used because the threads may be stripped off.
- not have thread locking materials applied. Unless recommended by the vehicle maker, do not use anti-seize or thread-locking materials. These materials do not completely dry and can act like an electrolyte. This increases the chance of galvanic corrosion.
- be torqued to the vehicle maker's recommendations. Examples of parts that may have torque specifications include door hinges, seat mounts, and seat belt mounts.

*These are examples of coated fasteners.*

Coatings typically consist of zinc and aluminum powder, which is baked on and cured. Fasteners with damaged coatings must be replaced because there are no aftermarket replacement coatings available.

Dacromet is a common name for the coatings on fasteners used in aluminum parts. Using noncoated fasteners increases the chance of galvanic corrosion.

Coated fasteners may have specific part numbers from the vehicle maker.

*Ford does not recommend reinstalling flow drill screws.*

Threaded fasteners that may be used for attaching aluminum parts include bolts and flow drill screws (FDS). EJOT (E-yacht) is another name that a flow drill screw may be called.

Flow drill screws:

- are made of steel.
- are installed by the vehicle maker.
- are not a self-tapping screw, but rather a screw that is spun at a fast speed and pressed against the aluminum. When the aluminum gets hot and soft, the FDS is pushed through the aluminum.

When the screw stops spinning, the threads form around the screw.
- are used to attach cosmetic and structural parts.
- may be reinstalled if the threads in the lower panel are not damaged. If the lower panel is damaged, at least one vehicle maker allows the lower panel to be drilled and tapped and an M6 bolt installed hand tight. Other vehicle makers may require a hemlock rivet be used to secure the two panels.
- are typically available as a service part.

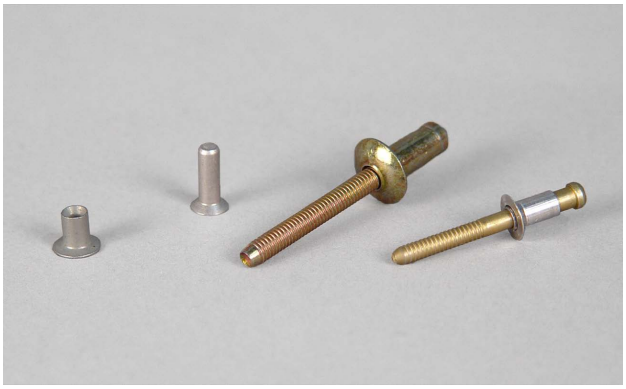
Ford recommends that when an FDS is removed, a hemlock rivet is reinstalled with adhesive in the location of the FDS. Do not reuse FDSs on Ford vehicles.

Some vehicle makers that use FDSs use them in a scenario where the top panel has an oversized stamped hole, and only the bottom panel is threaded. Ford installs the FDSs through panels that do not have holes in any of the panels. This causes both panels to be threaded. Therefore, FDSs are not reinstalled.

*Refer to the Video: Flow Drill Screws in the presentation. This video shows how a flow drill screw is installed by the vehicle maker and how they can be removed.*

**NOTE: This video shows reusing an FDS, which may be acceptable on other vehicle makes, but Ford does not recommend reinstalling.**

**Rivets**



*Rivets come in a variety of shapes and sizes.*

Aluminum-intensive vehicles generally use rivets for both new vehicle assembly and during repairs. The types of rivets used include solid, blind, and self-piercing rivets (SPRs).

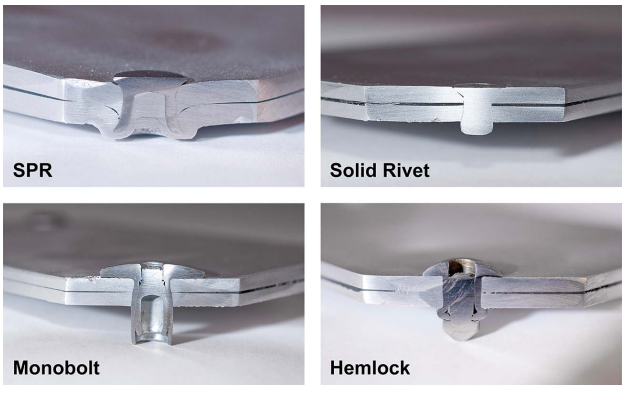
Some considerations for working with rivets include:

- using what is recommended by the vehicle maker when ordering rivets. If the rivets are ordered and shipped in separate packaging, keep the rivets in the protective bags to avoid damage to the coatings or corrosion.
- not storing aluminum-specific rivets with steel rivets. This could

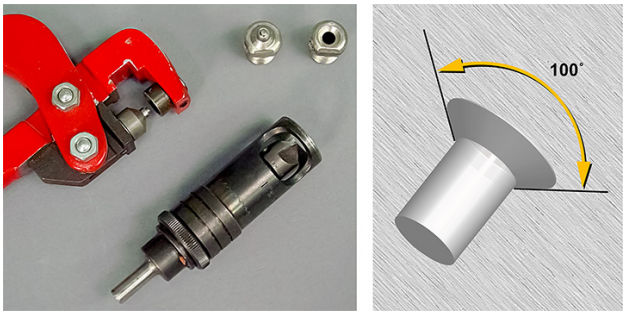
cause contamination to be transferred between the two rivets.
- special tooling that may be required to install some rivets. Although some of the tools can be purchased from different vendors, some tooling is only available through the vehicle maker.
- understanding that rivets are used for both structural and cosmetic parts.
- understanding that rivets are generally used in locations where spot welds would typically be used on a steel vehicle.

Rivets used by Ford during new vehicle assembly include hemlock and SPRs.

For repairs, solid, hemlock, or SPR rivets may be used. Although one type of rivet may have been used for new vehicle construction, the repairer has choices as to which rivet can be used in the repair process. For example, if a facility has access to an SPR gun, SPRs may be installed. If the SPR gun is not an option, solid rivets may be used in the location of the SPRs.




*Refer to Module 3, Demonstration: Different Types Of Rivets in the presentation for an example of four different types of rivets used in the automotive industry.*




*Countersink and dimpling tools are used to make 100° countersunk holes (left). A flush-mount solid rivet needs a countersunk hole (right).*

## Types

Solid rivets used on aluminum vehicles may be aluminum or steel. There are two types of solid rivets, countersunk and protruding-head. There may also be different diameter solid rivets used on a vehicle.

## Locations

There are no specific locations where only solid rivets are located. Solid rivets are used where identified by the vehicle maker and in areas where there is access to the backside of the part.

On passenger cars, solid rivets are not commonly used in new vehicle production. At least one vehicle maker uses solid rivets for repairs in locations

where SPRs and punch rivets were used for new vehicle assembly.

### Countersink

When countersunk rivets are installed, they must be installed into a panel that has a hole with a countersink to match the shoulders of the rivet. To make a countersunk hole, a hand-operated dimpling tool or countersink bit that matches the rivet head angle should be used. If a countersunk rivet is installed in a countersunk hole that is greater or less than the angle of the rivet, there will uneven contact along the rivet head, which causes poor sealing and a weak joint. 100° rivets are the common size with other shoulders varying in degree.

### Installation Tools

Tools used for installing solid rivets include:

- an air hammer and bucking bar.
- a hydraulic or pneumatic squeeze-type rivet tool.

### Installation and Inspection

When a solid rivet is installed, the rivet is installed in a hole that is just slightly larger than the shank of the rivet. First, the hole is drilled, then is deburred, followed by countersinking.

Following installation, the solid rivet is inspected for cracks or deformation of the head or bucktail. If the head does not fit flush against the panels, the rivet must be removed and a new rivet installed.

| OEM Attachment | Repair Attachment |
|---|---|
| Weld | Weld, Blind Rivet, SPR |
| Clinch | Blind Rivet, SPR |
| Blind Rivet | Blind Rivet, Weld |
| SPR | SPR, Blind Rivet, Weld |

*Shown is a chart identifying the original attachment method with some replacement attachment choices.*

Blind rivets are used for both new vehicle construction and collision repairs. Hemlock or monobolt rivets with a protruding or countersunk head may be used.

Blind rivets may be used:

- in locations where the vehicle maker originally used welds.
- where a clinch is located. If a factory clinch comes loose, a blind rivet can be used to lock the panels back together. This is done by drilling out the clinch and installing a rivet with adhesive where the clinch was located.
- where the vehicle maker installed blind rivets.
- where an SPR was used, but there is no access to the backside of the panel for reinstalling an SPR.

*These are some tools that are used for removing rivets.*

Blind rivets are removed by drilling. This requires a drill bit one size smaller than the body of the rivet. Then punch out the remaining part of the rivet.

Blind rivets may also be removed by grinding the head or bucktail and punching out the body of the rivet.

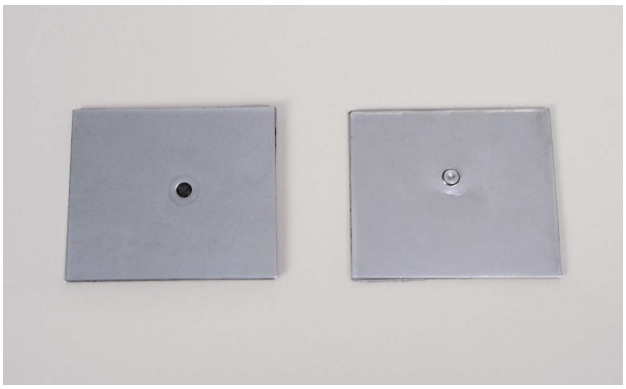
A blind rivet may be installed into a hole where an existing rivet was used, such as an SPR. If an SPR location is being used, ensure the hole is not larger than 6.5 mm. If a hole where the SPR was located is larger, the blind rivet will need to be located in a different location.

Blind rivets can be installed by using either a hand-operated or pneumatic rivet gun. If rivets with aluminum stems are installed, special gripping jaws are required. If aluminum-specific jaws are not used, the sharp teeth of the steel-rivet jaws will cut the stem off the rivet head and jam inside the rivet gun.

Ford supplies instruction sheets with replacement parts, and these instruction sheets will describe which rivets should be used in specific locations.

Install blind rivets by using existing hole if it is the correct size or dill a new hole and deburr.

*Refer to the Video: Hemlock Versus Monobolt Rivets in the presentation. This video discusses how the two different types of rivets function when installed in a panel.*



*Shown is the head of an SPR (left), and the backside (right).*

SPRs are:

- a high-strength steel fastener with a tin / zinc coating.
- installed by the vehicle maker and can also be installed using special equipment during vehicle repairs to duplicate the original attachment process.
- used in areas that are typically spot welded on comparable steel vehicles.

Depending on the vehicle maker's build design or repair recommendations, SPRs may be located virtually anywhere on a vehicle structure. An SPR may be used in both exterior / cosmetic and structural locations.

*Some riveting tools have special dies for removing an SPR.*

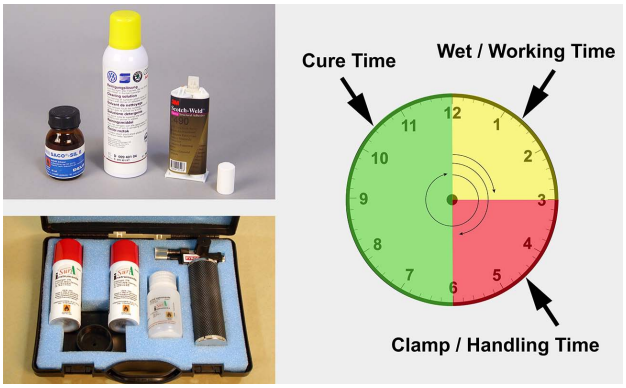
SPRs may be removed by:

- pressing. If the SPR allows access to both sides of the part, pressing is the cleanest method. When pressing an SPR out, no steel dust or shavings are spread around the repair area.
- welded-on studs. If the proper attachments and pneumatic riveting gun are unavailable, stainless steel weld-on studs can be welded to the head of the SPR. Then the SPR can be pulled out. When removing an SPR using this method, make sure to maintain steady pressure and hold the stud at a right angle to the SPR head. This prevents the weld-on stud from breaking off.
- drilling. Having access to both sides also allows for drilling from the backside. When drilling from the backside of the rivet, the fingers of the SPR help keep the drill bit centered. This is an easier method than drilling from the front side.
- grinding. Grinding on an SPR can be effective with removing the rivet, but steel debris can cause galvanic corrosion if not removed.

When installing an SPR:

- access to both sides of the panel is necessary.
- install near the original location.
- it must be installed in a clean area of the flange that does not have a hole.

*Refer to the Video: SPR Installation And Removal in the presentation. This video discusses how an SPR is installed, and the different ways an SPR may be removed.*




*Vehicle makers may have different recommendations for pretreatment before adhesive is applied.*

When preparing an aluminum part for bonding, always follow the vehicle or product maker's recommendations, which may include:

- scuffing the E-coat. This gives the adhesive and flange a mechanical bond.
- removing the E-coat. This provides a predictable bond surface that does not depend on the integrity of the E-coat.
- flame treating the bare flange. The bonding surface is cleaned and then treated with a Pyrosil torch and primer.
- abrading the flange using a silica stone. Then a brush-on primer is applied to the bonding surface.
- the use of a special P120 grit sandpaper and spray-on primer.

Never abrade an aluminum part with material coarser than P80.

**Ford recommends the E-coat be removed, the surface cleaned, and then the adhesive is applied.**

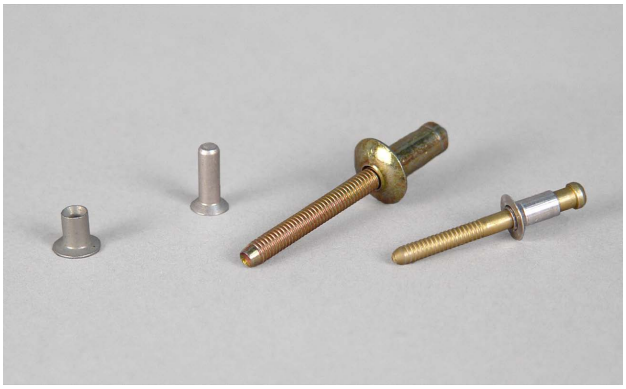
**Riveted Part Replacement**

*Shown are different tools that can be used to remove rivets.*

When removing a riveted part, consider:

- the type of rivet was used.
- access to backside. This can help determine how the rivet will be removed.
- working from the damaged panel side. If only the inner or outer panels are being replaced, it may be best to work at removing the rivet from the damaged side of the panel. By doing this, there may

not be concerns for thinning of the panel from grinding. If a rivet is being removed by grinding off the backside and punching it out, always support the area where the rivet is being removed. Support can easily be done by using a socket and ratchet pressed against the area where the rivet is being removed.

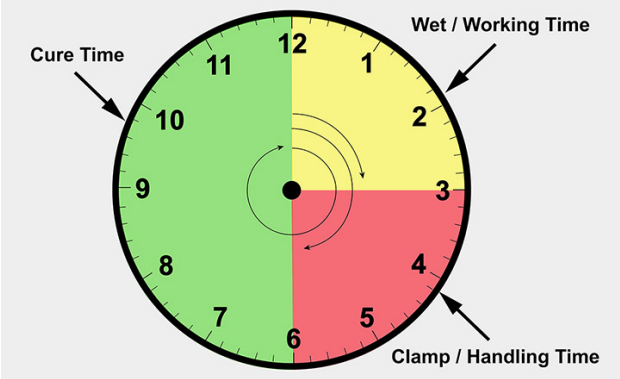


*Shown in the picture are examples (left to right) of an SPR, solid, hemlock, and monobolt rivets.*

When deciding what reattachment rivet should be used, follow the vehicle makers instructions. If there are no instructions from the vehicle maker, considerations for rivet use include, but are not limited to:

- access to the backside.
- having enough room to install an SPR between the original rivet locations.
- glass or weatherstrip applications.

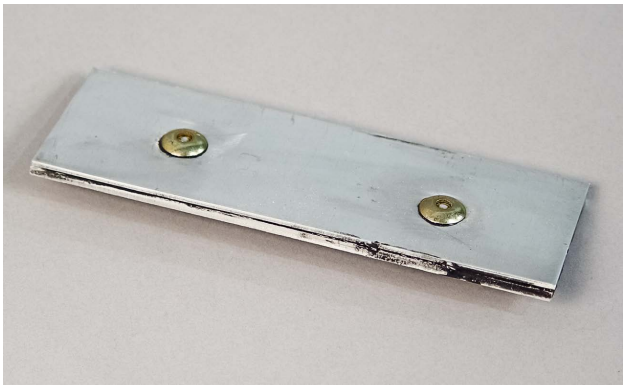
Rivets must not be installed without adhesive.




*It is important to understand the cure, wet, and clamp times when working with adhesive.*

When working with adhesives, application considerations include:

- temperature. As the temperature increases, open, clamp, and cure times decrease. The reverse is true when the temperature decreases.
- wet / working time, also known as open time. The larger the part or assembly, more open time is generally needed to allow for extra time for product application and panel installation.
- bond-line thickness. Bond-line thickness is the recommended thickness of the adhesive in the mating flange after clamping. Most adhesives contain glass beads that control this thickness.
- clamp / handling time. This is the amount of time that the panels must remain clamped per product makers' instructions.
- cure time. Cure time is the time required for an adhesive to cure at a specific temperature and humidity to achieve full strength.

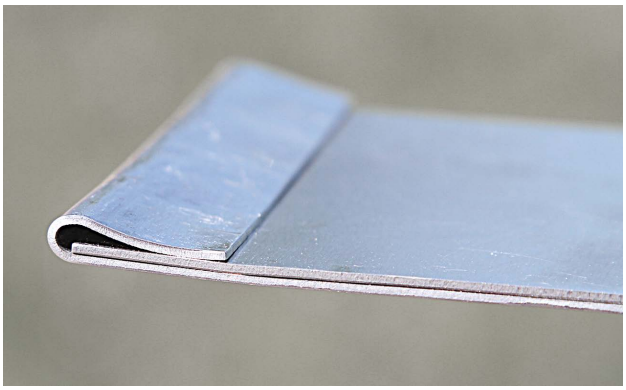


*Rivets are always used with adhesive.*

When preparing to attach a rivet-bonded part, identify:

- which type of rivet or rivets are recommended by the vehicle maker.
- if a hole, dimpling, or countersinking is necessary.
- which type of clamps will be required.
- what preparation steps are required for the mating flanges.
- the proper adhesive and application requirements.

**Hem Flanges**



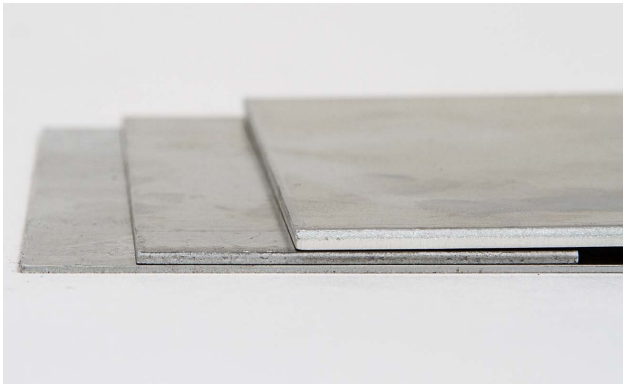
*A rope hem flange is designed to prevent cracking as it is being made.*

Hem flanges are commonly used on:

- door skins.
- wheelhouse flanges.

Aluminum hem flanges are made at the vehicle maker before the 6000 series aluminum is bake-hardened. By doing this, the aluminum is formed while it is still soft.

A rope hem flange is used for installing replacement parts that are already heat-treated. A rope hem flange allows for a larger radius to be made as the replacement panel is installed on the part.



*Thicker material will be more difficult to roll a flange without cracking.*

When hemming a panel, consider the:

- alloy of the aluminum. Some alloys like 5XXX series alloy materials get their strength from work hardening. This means as the flange is being rolled over and set, the area where the part is being bent is gaining strength.

6XXX series aluminum gets its strength from heat treating. This means that service parts will be shipped to the repair facility at their hardened state. Depending on the specific alloy, bends in the part may require a gradual radius bend.

- thickness of the panel. Although the type of alloy can affect the strength, so can the thickness. The thicker the material, the more prone it is to cracking.
- visibility of the area. If the area is on a door assembly, the visual appearance is important.
- special tools available that will help create a gradually rolled hem flange.

Ford is offering a replacement door skin as a service part. Before installing the door skin, ensure that the door frame is straight.

Exterior panels on the 2015 Ford F-150 are made from 6022 aluminum alloy.

*Keep tools for working with aluminum separate from tools used with steel to limit the possibility of contamination.*

When forming the flange on an aluminum part, repair tools that may be used include a:

- hammer and dolly.
- hem removal tool. There are some specialty tool vendors that offer tools that will open a hemmed flange. This tool is offered by Rotunda and part numbers are 501-078/1 and 501-078/2.
- hem installation tool. This tool gradually folds the flange, decreasing the possibility of cracking the rolled edge. One option that is offered by Ford is a Rotunda tool, part number 501-080. This tool is used to roll the flange of the door skin.

*Refer to the Video: Rope Hem Flange in the presentation. This video discusses how a rope hem flange is made.*

## Aluminum Welding

**Position Statement Table of Contents**

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- Use of Recycled (Salvage) Collision Parts (June 1, 2004)
- Use of New Aftermarket (Imitation) Collision Parts and Air Bag Systems (June 1, 2004)
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- Clearcoat Blending Procedure Not Recommended (October 6, 2009)

*Follow the welding recommendations provided by Ford.*

Welding may be recommended by the vehicle maker for repairs to exterior or unitized structural parts. When welding aluminum:

- plug welds may be used in place of rivets or where the vehicle maker used spot welds.
- continuous welds may be used at factory seams or sectioning joints.
- typically argon shielding gas is used.
- specific wire recommendations should be followed. Ford recommends 5554 alloy electrode wire.

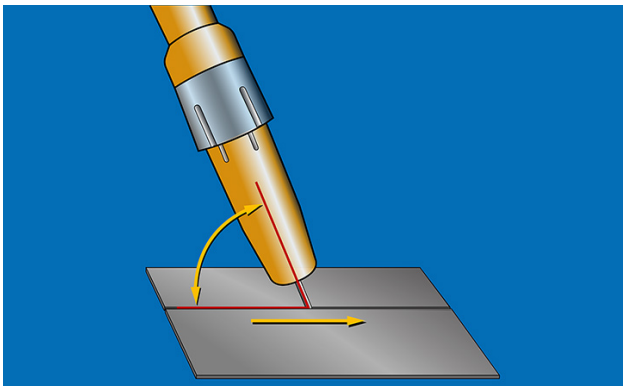
Ford uses GMA (MIG) welding during vehicle construction on the 2015 F-150 Super Crew upper B-pillar reinforcment joint.


*Argon purity should be verified to ensure sound welds (top left). A spool gun is a common tool used for welding aluminum (bottom right).*

Special equipment necessary for welding aluminum includes, but is not limited to:

- 220-volt welding machines that are capable of welding in the transfer mode of pulse (synergic) spray.
- the use of a spool gun for machines that may serve dual purpose for welding aluminum and steel.
- 100% argon shielding gas with a purity of 4.6, which helps ensure sound welds.
- alloy-specific welding wire. Always use the electrode wire recommended by the vehicle maker.
- a nylon or teflon liner for the welding gun.
- specific contact tips that have an oversized hole to accommodate the aluminum electrode wire as it expands from the heat. Contact tips may be made specifically for aluminum welding electrode wire. These have an "A" or "AL" stamped on the contact tip. There may be performance issues if the same

contact tip size is used for both steel and aluminum.
- shielding gas nozzles that are a larger diameter to accommodate the increased gas flow.



*Welding torch position and travel is critical for a clean weld.*

There are differences when welding aluminum versus steel include:

- greater wire stick-out from the welding torch. This will result in the welding torch being further back from the welded surface.
- using the push technique. This technique is when the weld bead is being pushed instead of being pulled. This is done to enhance the cleaning action from the shielding gas and to preheat the area being welded.
- starting with a slow travel speed when welding. This is because aluminum has a greater thermal transfer efficiency than steel. When heat is put into an aluminum part, the aluminum transfers the heat throughout the part, unlike steel which holds the heat in one area. Because of this thermal transfer efficiency and the low melting point of aluminum, the welding travel speed needs to increase as the welding is moved across the panel.
- using higher amperage on aluminum than may be used on steel.


*Only use the recommended electrode wire identified by the vehicle maker when doing welding repairs.*

When welding aluminum, there are general alloy recommendations that are published by organizations such as the Aluminum Association and AlcoTech.

**Ford recommends using ER5554 on their aluminum vehicles, with 1.2 mm diameter wire.**

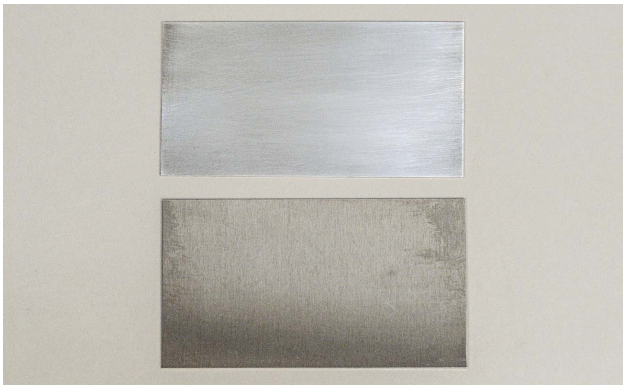
Some vehicle makers allow the use of 4XXX series electrode wire when welding on 6XXX series parts, and 5XXX series electrode wire when welding on 5XXX alloy parts. The recommended electrode wire is generally going to be an engineering decision by the vehicle maker. If there is not a

recommended wire alloy, the material being welded may be the deciding factor regarding what electrode wire is used.


*Ensure the shielding gas is pure argon.*

When welding aluminum and working with the shielding gas:

- pure argon gas is the preferred shielding gas. Argon offers good cleaning action to the area being welded and helps manage heat in the weld zone.
- argon shielding gas that is of a lower purity than 4.6 may offer contamination issues to the weld bead. In a repair facility, it is not possible to test gas purity, but if shielding gas is suspected to be contaminated, exchange the gas tanks and make a test weld. Argon gas purity is measured on a scale up to 5.0. Argon with a purity of 4.6 means that it is 99.996% pure. The number 4.6 is a code where the first number, 4, is the number of 9's in the purity. The last number, 6, is the last number of the purity. Argon with a purity of 5.0 is 99.999% pure. Verifying argon purity is done by talking to the gas supplier. Some suppliers will even offer purity certification. Though bad gas is not common, one way contamination can occur is if an empty cylinder valve is left open. By leaving the valve open, moisture can enter the cylinder and corrosion can begin on the inside. Even though the tanks are supposed to be purged, the corrosion and contamination can potentially affect the shielding gas and cause a poor weld.
- mixed shielding gas is not generally used in aluminum repair.



*Aluminum oxide (bottom) is a contaminant and requires removal (top).*

When preparing an aluminum surface for welding, the surface should be cleaned of all coatings, and then wiped clean with a solvent cleaner to remove any surface contamination.

After the surface has been wiped clean, remove any aluminum oxide from the weld zone using sandpaper or a stainless steel brush. Aluminum oxide will contaminate a weld because it has a high melting temperature of 3,700°F and holds moisture.

Immediately before welding, clean the weld area to ensure there are no contaminants in the weld zone.

*Only finish welds that are visible or interfere with other parts.*

When an aluminum part is welded, not all welds require dressing. When determining if a weld should be dressed:

- are the welds visible? If the welds are not visible, and will not interfere with other parts being attached, dressing may not be necessary.
- were the welds dressed by the vehicle maker?
- could dressing the weld compromise the integrity of the repair area? Use caution to ensure base metal adjacent to the weld is not thinned.

*Refer to the Video: Aluminum GMA (MIG) Welding Techniques in the presentation. This video discusses considerations when welding aluminum and different techniques that may be used when welding aluminum parts.*

**Welded Panel Replacement**


*When grinding, do not use abrasives that were used on steel to avoid cross contamination.*

When removing a welded panel:

- removal is done similar to that of steel vehicles, but caution should be used as aluminum material will be removed faster than steel.
- remember, when grinding or sanding aluminum, slower speeds with light pressure are preferred.

- never grind or sand with abrasives coarser than P80 grit.


*Practice welds should be completed before welding on the vehicle using the same techniques and materials.*

When making practice welds:

- duplicate the weld that will be made on the vehicle. Duplicate the position, be it overhead, vertical, or flat, and also use the same material stack and alloy material. When making practice welds, it is also important to duplicate the root gap and plug weld size of the weld being made on the vehicle.
- use the recommended electrode wire. Ford requires ER5554, 1.2 mm diameter wire. Only use the electrode wire that is identified by the vehicle maker.
- remove any aluminum oxide.
- degrease the test material. Always remove any grease or oil that may contaminate the weld area.

*Shown are coatings being removed with a stainless steel wire wheel.*

When preparing the vehicle and replacement parts:

- remove existing welds or coatings.
- straighten the flange.
- clean surfaces with wax and grease remover to remove any contaminants.
- clean both sides of both the vehicle and the replacement part. When cleaning the weld joint area, remove coatings 50 mm away from each side of the weld zone area. This includes paint coatings, foams, and adhesive residue.
- do not use weld-through primer or any coatings in areas where welding will occur.
- ensure tight joint fit-up.
- ensure any backings that are being used contact both sides of the root gap. This will help bridge the heat between both panels and help control heat distortion.


*Grinding wheels may be identified as aluminum-specific abrasives (left). Carbide cutting tools can be used to remove a weld bead (right).*

After a part has been welded:

- closely inspect the welds to identify any possible defects. A dye penetrant may be used to verify there are no defects in the welds.
- if a defect has been identified, grind away the weld and reweld the area. For example, a carbide bit may be used.
- dress the weld if necessary.

*Some vehicle makers use spot welds on their vehicle, even though spot welds cannot be duplicated in repairs.*

Spot welds are:

- generally used for new vehicle construction.
- not duplicated during repairs. This is because spot welds are not easily made due to power requirements and machine limitations. To make a spot weld in aluminum without the use of steel plates, to add resistance and heat, approximately 25,000 amps would be required. Currently, about 12,000 amps are required to make an effective weld in steel.
- often replaced with rivets.

As technology progresses, a spot welding machine becoming an option for vehicle repair is a possibility. As more aluminum is used on vehicle structures, alternative repair options will drive this technology for aftermarket repair facilities.


*Shown is an Aluspot aluminum repair station.*

When straightening cosmetic / exterior panel damage:

- a stud welder designed for aluminum may be used.
- aluminum studs are welded to the damaged area. After the panel is

returned to the proper shape, the studs are removed and the repair area is prepared for refinishing.
- using too high of amperage will create a hole in the panel. Generally, 99 amps is adequate for attaching a weld-on stud.
- the use of heat and stress-relieving techniques should be used to get the molecules in the metal to move. Do not overwork the part, as stretching of the part will occur.
- gentle hammering on the part will help damage be removed when straightening.

**Module Wrap Up**

Topics discussed in this module included:

- where a clinch may be used.
- the different types of fasteners used with aluminum.
- what types of rivets are approved for use on Ford vehicles.
- what is required for replacing a riveted part.
- why aluminum flanges are treated differently than steel.
- what is different with welding aluminum versus steel.

# Module 4 - Body Design And Construction

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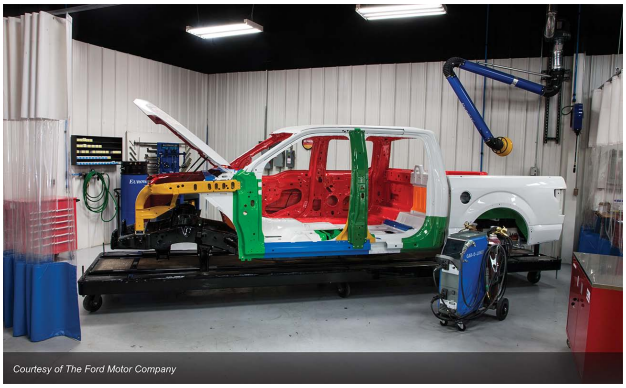
**Body Assembly Materials Overview**

Learning objectives for this module include:

- describing what materials are used at different locations on the vehicle.
- explaining what repairs can be done to the magnesium radiator core support.
- describing how close to a hinge or striker a cut line can be for repairs.
- explaining the repair process for the laminated dash panel.
- describing the repair process for the extruded rocker panel.
- describing what type of windshield adhesive is required for stationary glass installation on aluminum vehicles.




*The 2015 F-150 should be repaired in a designated area that is kept clean from debris that could cause galvanic corrosion.*

The aluminum alloys used in the F-150 are:

- 6111 for the unitized structure.
- 6022 for the exterior panels.

The radiator core support has been made of magnesium since the 2004 model, and the 2015 F-150 will also be magnesium. Steel is used in several areas on the vehicle; the frame, laminated steel cowl, bumpers, door intrusion beams, and door hinges.

When doing repairs on the 2015 F-150, repair area cleanliness is very important. Ford recommends that aluminum parts and vehicles be repaired in an area segregated from nonaluminum (steel, composite, carbon fiber) vehicles and parts. This may include a:

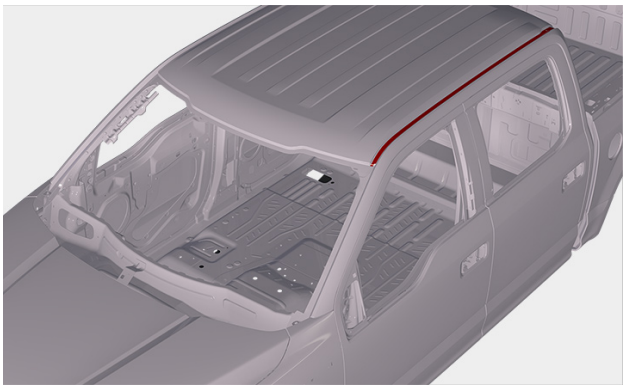
- designated repair facility.
- curtained off repair bay / area.
- designated room.

According to Ford, the repair area used for a 2015 F-150 must be, at a minimum, segregated with curtains. These recommendations are in place to control the risks of galvanic corrosion from fallout caused by doing repairs on steel or carbon fiber vehicles.

Ford will allow the aluminum repair area to be used for repairing nonaluminum parts and vehicles. When aluminum repairs are not being performed, the area must be thoroughly cleaned after the previous vehicle has been repaired.

Proper workplace cleanliness will ensure no nonaluminum dust or particles from sanding, grinding, or drilling remain in that area.

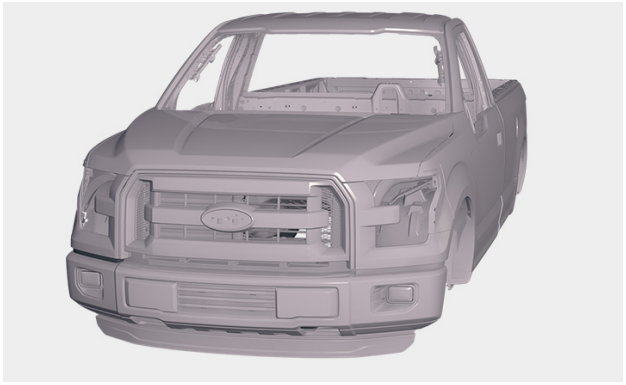
Note: Tools used for aluminum repair should not be used in the repair of other types of vehicles.



*Laser welds are only made during new vehicle construction.*

Laser welds are used where the roof attaches in the ditch area and the A-pillar windshield flanges.

**Exterior Body**

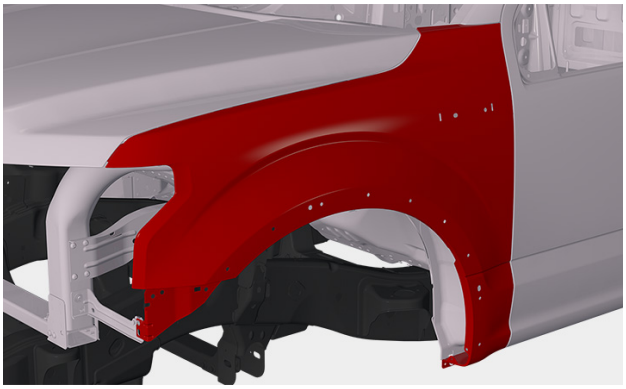


*The front and rear bumpers on the 2015 F-150 are made of steel.*

The front and rear bumpers on the 2015 F-150 are made from steel, similar to the materials used in previous models.

**Vehicle Maker Note**

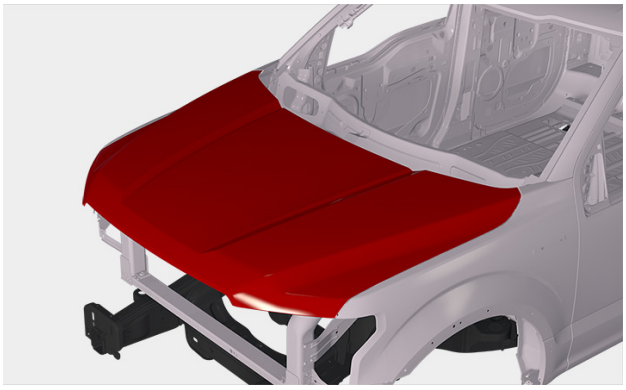
Ford provides instructions with their service parts.



*The stamped fenders on the 2015 F-150 are bolted to the vehicle body.*

The fenders on the 2015 F-150 are:

- made from stamped sheet aluminum.
- made from 6022 aluminum alloy.
- attached to the structure with bolts.

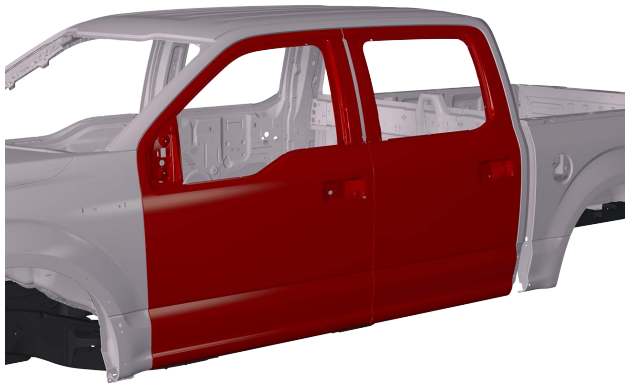


*Steel hinges attach an aluminum hood to an aluminum body.*

The hood on the 2015 F-150:

- is stamped.
- is 6022 aluminum alloy.

- has an underside reinforcement that allows access to the backside of the hood for removing damage.
- is bolted to steel hinges without an insulator between the two materials.



*Doors on the 2015 F-150 are attached to the body with steel hinges.*

The door frames and skins on the 2015 F-150 are:

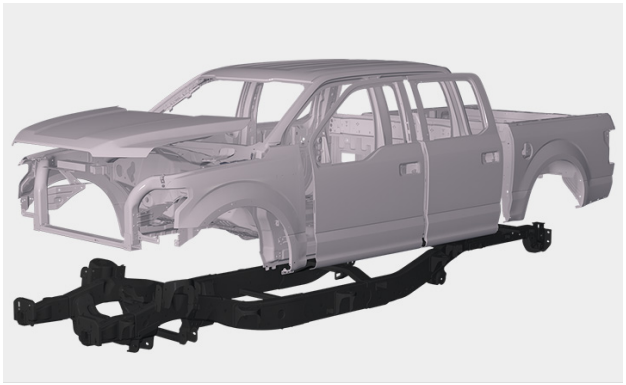
- stamped.
- 6022 aluminum alloy.
- available as a complete door assembly or door skin.

The level of damage will determine what parts should be replaced.

The door hinges are:

- steel.
- adjustable at both the mounting locations to the body and at the door.

The intrusion beam in the doors is made from boron-alloyed steel, and for no reason should the intrusion beams be repaired.



*The aluminum outer body panels on the 2015 F-150 have different repair considerations than steel models.*

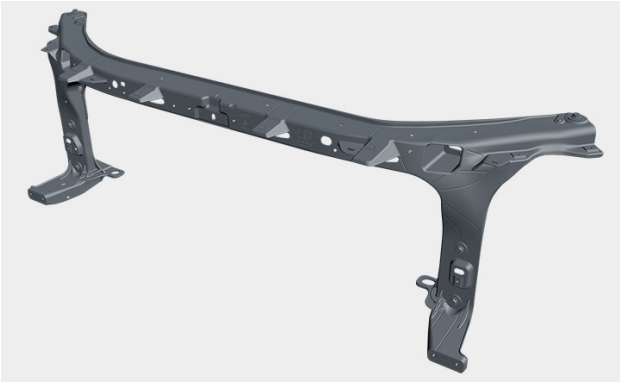
The exterior body panels on the 2015 F-150 are:

- 6022 aluminum alloy.
- attached by the vehicle maker using SPRs and adhesives.
- replaceable as an assembly at factory seams or at the approved sectioning locations determined by Ford.
- reattached using SPRs or solid rivets. Hemlocks are not used because of the protruding head.

When reattaching panels on the 2015 F-150, the repair technician has options for which attachment method they would like to use. Not all repair facilities will have access to an SPR gun, so the use of solid rivets is acceptable.

**Cab Repair Options**

*Have your instructor lead you through the Activity: RTS Links. This activity shows the RTS link to the Ford Service Instructions.*

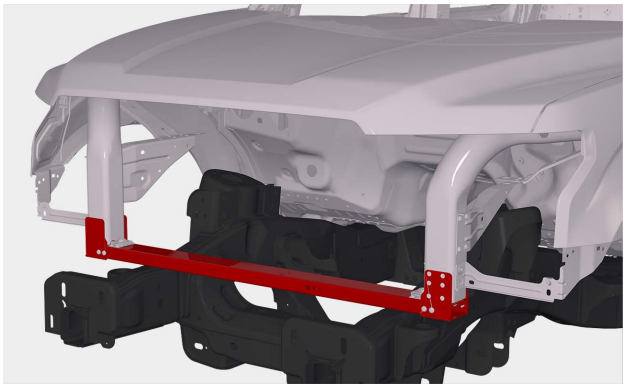


*There is no repair recommendations for the magnesium radiator core support.*

The radiator core support is:

- magnesium.
- not repairable. Cast magnesium, like cast aluminum, is not repairable.
- bolted to the vehicle structure.
- replaced as an assembly when damaged.

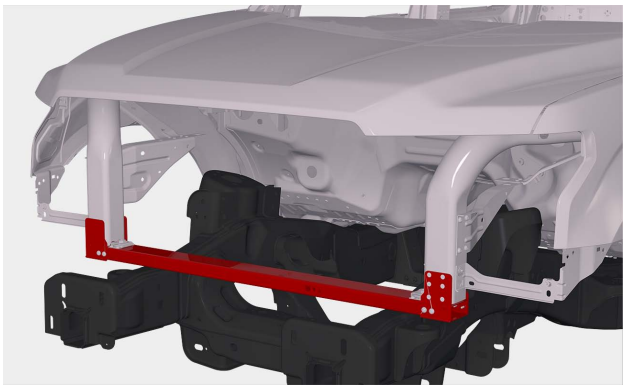
The fasteners used to attach the radiator core support are coated to resist galvanic corrosion.



*The lower radiator core support on the 2015 F-150 connects to both apron tubes.*

The lower radiator core support:

- is attached to the frame with bolts.
- uses rubber bushings to insulate the aluminum from the steel.
- is a multi-cell aluminum extrusion.



*When replaced, the lower radiator core support is attached to the apron tubes with hemlock rivets.*

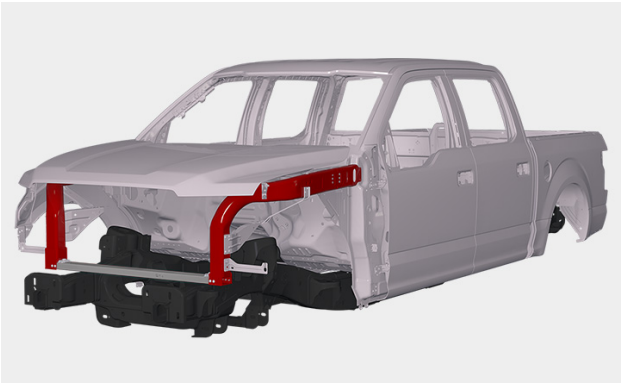
When replacing the lower radiator core support:

- unbolt the lower support from the attachment point at the frame.
- remove the FDSs and SPRs from where the apron tube attaches to the lower support.
- apply anti-corrosion compound to the backside of the repair areas.

For reinstalling the lower radiator core support, hemlock rivets are used in place of the FDSs. The hemlock rivets are installed with the use of adhesive and installed in 6.5 mm holes.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

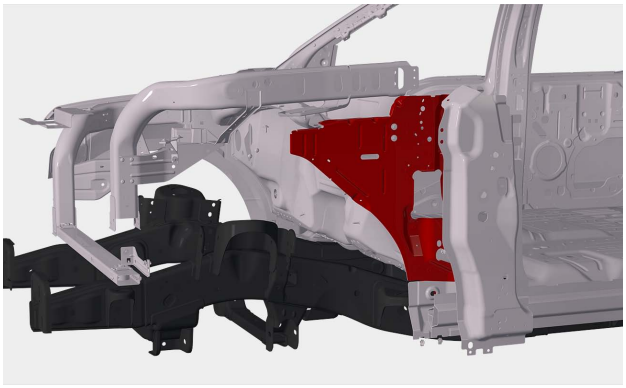
- Front Radiator Support



*The 2015 F-150 apron tube is a hydroformed part.*

The hydroformed apron tube attaches to the:

- hinge pillar cowl area.
- inner fender reinforcement.
- lower radiator core support.

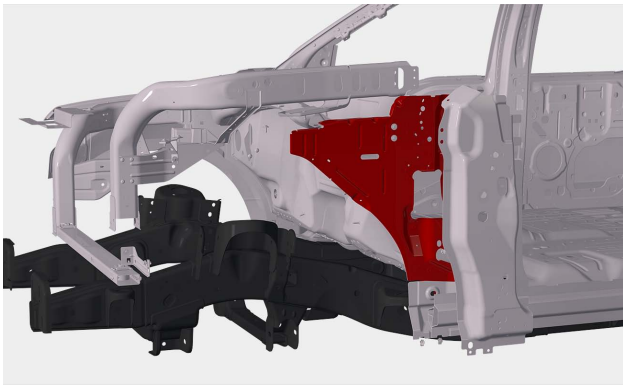


*Rivets secure the apron tube to the body structure.*

When making repair or replace decisions for the apron tube, some of the considerations include:

- any kinks in the part will require replacement.
- any cracks from the collision or from straightening will require part replacement.
- no sectioning procedures for this part.

The apron tube may be repaired, however, it is limited to very minor damage. **When straightening the apron tube, the part may be heated to 425°F.**



*Use care when removing rivets that secure the apron tube to the inner fender reinforcement.*

Replacement of the apron tube includes removing:

- the hood, fender and liner, front bumper, and door assembly.
- any structural misalignment.
- the eight FDSs from the front lower radiator support.
- the rivets that connect the apron tube to the cowl.
- the threaded fasteners that connect the apron tube to the cowl and hinge pillar.

A heat gun will help break the adhesive bond.

**Per Ford, using heat (not exceeding 425°F) to loosen a rivet bonded panel should only be done when all panels in the joint will be replaced or separated and new adhesive applied.**

*Holes are drilled for the replacement rivets.*

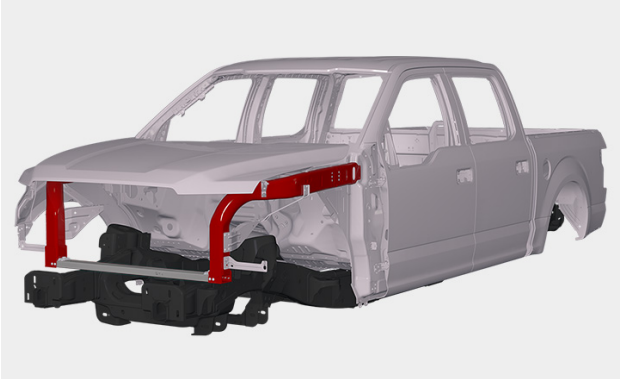
Before attaching the replacement apron tube, ensure any damage to the inner cowl is removed. To install the apron tube:

- test-fit the replacement part, and verify the position with upperbody measurements.
- clean and prepare the adhesive bonding surfaces with no coarser than P80 sandpaper.
- drill any necessary holes in the replacement part and deburr.
- apply adhesive.
- install the replacement part, verify alignment, and install all fasteners during the adhesive work time.

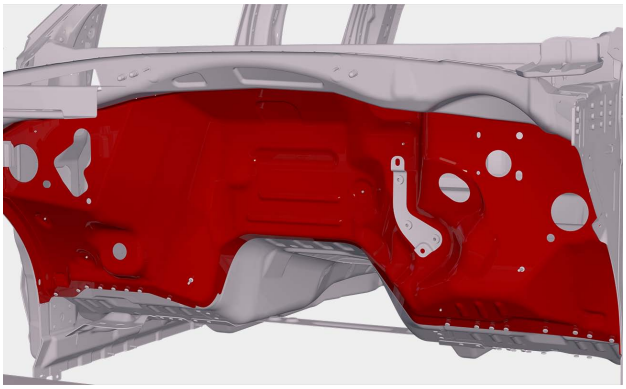
For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- Front Rail

*Refer to the Video: Apron Tube Replacement in the presentation. This video discusses how the apron tube is replaced on a 2015 F-150.*



*Refer to Module 4, Demonstration: Apron Tube And Lower Tie Bar Guidelines in the presentation for a visual example of the parts, their location, and marking the attachment locations.*

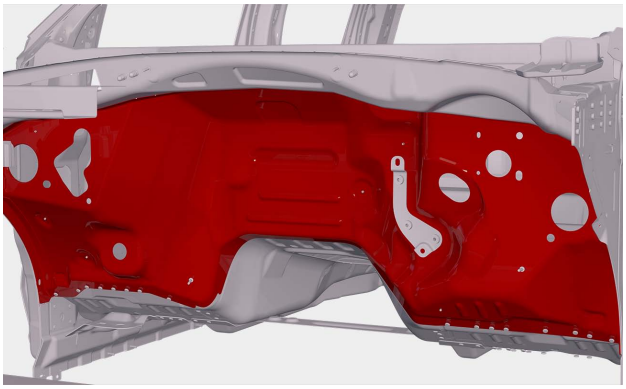


*The Quiet Steel cowl panel is used to control noise.*

The cowl panel, also referred to as a dash panel, is made of Quiet Steel, the same as the 2004 - current Ford F-150 model years. Quiet Steel is Ford's trade name for laminated steel, which is two outer layers of steel with a plastic core.

When making repair versus replace decisions for the cowl panel, consider:

- that the 2015 F-150 cowl is attached by rivet bonding with SPRs from the factory.
- only using cold-straightening techniques or replace the cowl panel.
- Ford offers the cowl panel as an entire assembly.
- when the cowl panel is installed, the E-coat is left intact to work as a barrier to the aluminum to help reduce the chance of galvanic corrosion.

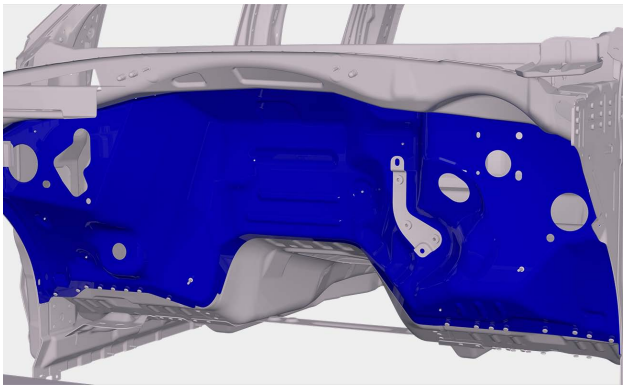


*For removal, rivets are removed from the perimeter of the cowl panel.*

Cowl replacement is not a common procedure. When replacing a damaged Quiet Steel cowl panel:

- remove all parts to gain access to the cowl on both sides.
- remove the SPRs that attach the cowl to the cab.
- use controlled heat to soften the adhesive bond and separate the bonded joints.

**Per Ford, using heat (not exceeding 425°F) to loosen a rivet bonded panel should only be done when all panels in the joint will be replaced or separated and new adhesive applied.**



*The replacement part is secured using rivet bonding.*

When installing the Quiet Steel cowl panel:

- wipe the E-coat with wax and grease remover.
- scuff the E-coat. The E-coat is an additional barrier between the steel and aluminum.
- prepare the mating flanges on the cab for adhesive application.
- test-fit the cowl, drill necessary holes, and deburr.
- apply the adhesive covering any bare aluminum areas.
- set the cowl in position and hold in place with clamps, clecos, or rivets as alignment pins.
- install the remaining rivets in the locations around the perimeter of the part. Set the rivets when the part is completely in position during the wet time of adhesive.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website, Outer Cowl Top, Cowl Top Inner, Cowl Side Panel, Body Dash Panel.

*The outer body side panel may be sectioned or welded if cracked or torn.*

The outer body side panel (uniside) is rivet bonded to the vehicle structure, and repairable depending on the type, location, and extent of damage.

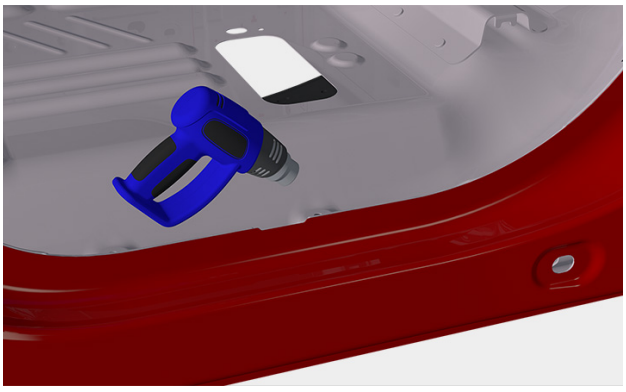
The outer body side panel is considered a cosmetic / exterior part and may be welded if it is cracked or torn.

*When sectioning, follow Ford's guidelines for cut locations.*

When sectioning the outer side panel:

- Ford is allowing sectioning of the outer body panel based on the damage.
- do not section within 50 mm of hinges, strikers, holes, or highly formed areas.
- the repair seam may be welded or adhesively bonded using a butt joint with backing. These considerations should never be applied to structural repairs.

*Refer to Module 4, Demonstration: Outer Body Side Panel Guidelines in the presentation for a visual example of the part, and marking the areas where Ford does not recommend sectioning.*



*Controlled heat will soften adhesive and aid in panel separation.*

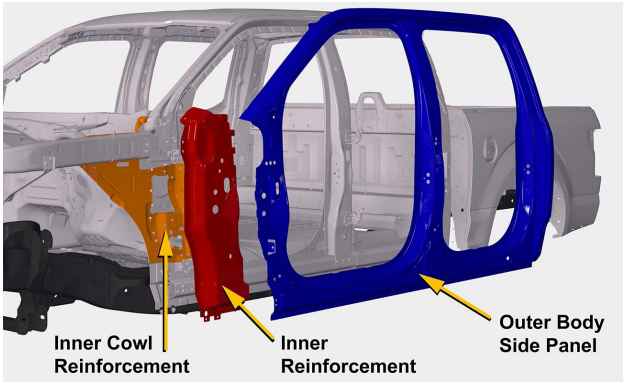
When sectioning an outer body side panel:

- identify cut locations and cut the outer body panel, ensuring no damage is caused to any inner structural parts. If a cut is made around the A-pillar / roof rail, use caution as the outer panel and the reinforcement are nearly touching.
- remove rivets in a manner that takes into consideration how the replacement part will be reinstalled. Do not cause damage when removing rivets.
- apply heat to separate panels after all the fasteners have been removed. **Per Ford, using heat (not exceeding 425°F) to loosen a rivet bonded panel should only be done when all panels in the joint will be replaced or separated and new adhesive applied.**
- clean surfaces that will be reused. This includes removing existing adhesive and cleaning the sectioning joint location so it provides a clean joint.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- All Cabs - Rear Body Filler Panel
- Regular Cab - Door Opening Panel, C-Pillar Outer Panel
- Super Cab - Door Opening Panel, C-Pillar Outer Panel
- Crew Cab - Door Opening Panel, B-Pillar Outer Panel

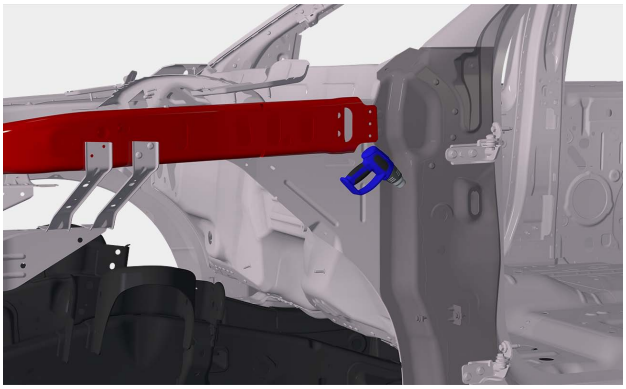
*Refer to the Video: Outer Body Side Panel Partial Replacement in the presentation. This video discusses a Ford-approved process for sectioning a portion of the outer body side panel.*




*The inner reinforcement is partially covered by the outer body side panel.*

The hinge pillar is:

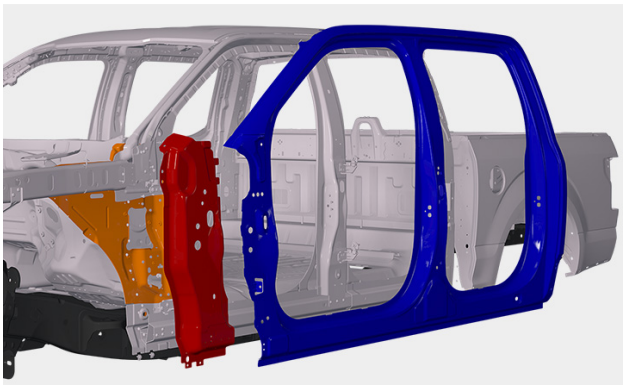
- made of three parts. The outer body side panel, inner reinforcement, and an inner cowl reinforcement.
- stamped from 6111 aluminum alloy.
- rivet bonded to the cab assembly.



*The apron tube and outer body side panel require removal to gain access to the hinge pillar reinforcement.*

To remove the hinge pillar reinforcement:

- remove the apron tube.
- cut and remove the outer body side panel.
- remove the inner reinforcement.
- remove the rivets and heat the adhesive to remove the inner cowl reinforcement. **Per Ford, using heat (not exceeding 425°F) to loosen a rivet bonded panel should only be done when all panels in the joint will be replaced or separated and new adhesive applied.**



*Rivet bonding is used to reattach the hinge pillar reinforcement.*

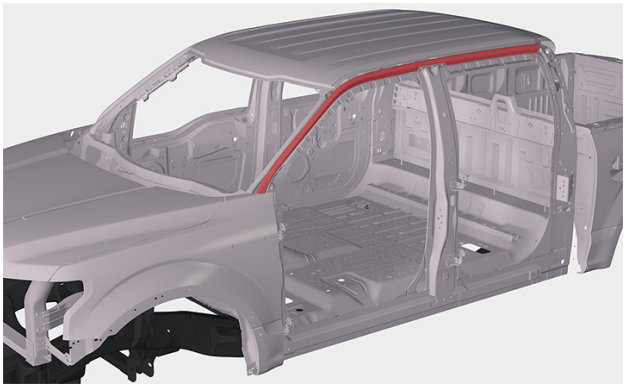
To install the hinge pillar reinforcement:

- remove any damage, and make the structure three-dimensionally correct.
- prepare all mating flanges for adhesive and rivets.
- apply adhesive to the area between the door hinges on the outer reinforcement surface.
- fit and install outer body side and door hinges. This is done like this because from the vehicle maker, there are SPRs installed, and the only riveting option would require hemlock rivets this would create a visual distraction for the vehicle owner.
- apply adhesive, measure and hold the outer panel in position, install rivets, and allow it to cure.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- Hinge Pillar

*Refer to the Video: Hinge Pillar Reinforcement Replacement in the presentation. This video discusses how a damaged hinge pillar is replaced.*

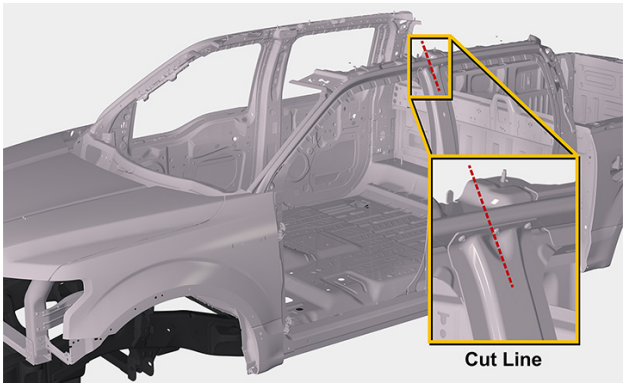


*The A-pillar reinforcement / roof rail offers structural support to the upper structure of the body.*

The A-pillar reinforcement / roof rail:

- is a one-piece extrusion that extends from the hinge pillar reinforcement to the back of the cab.
- is 6111 aluminum alloy.
- can be sectioned above the B-pillar on Super Crew models.

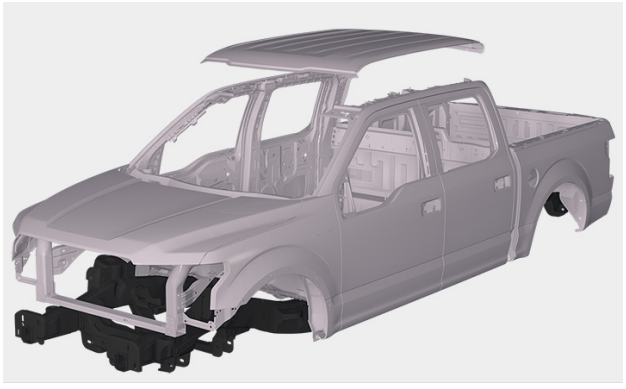
If a partial A-pillar reinforcement / roof rail is installed, welding will be required for the repair.




*There is only one recommended sectioning location for the A-pillar reinforcement / roof rail.*

When determining if the A-pillar reinforcement / roof rail may be sectioned, consider:

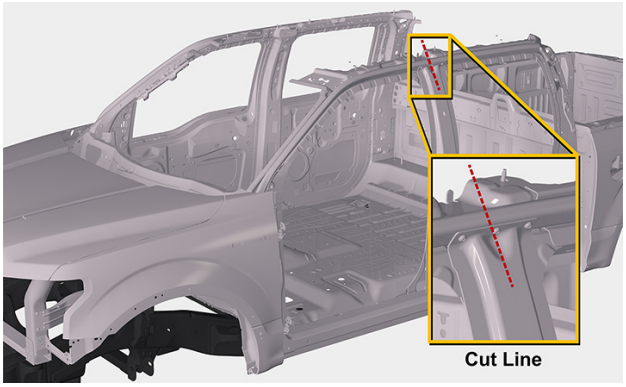
- the location of damage. Not all damage is repairable by installing a partial part.
- where Ford identifies an approved cut location.



*The roof must be removed to gain access to the A-pillar reinforcement / roof rail.*

The sectioning procedure for the A-pillar reinforcement / roof rail is limited to the 2015 F-150 Super Crew. When removing the A-pillar reinforcement / roof rail:

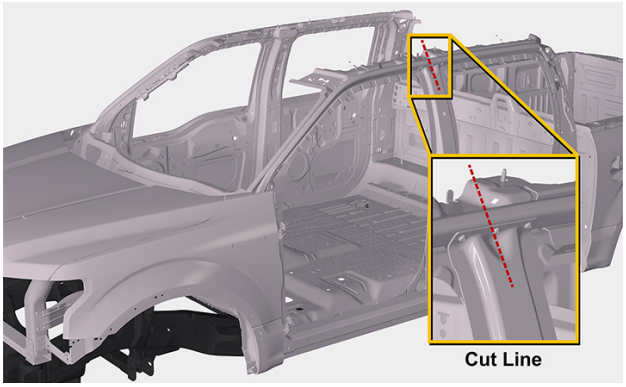
- remove the roof. The roof rests on top of the outer body side panel flange.
- remove the upper windshield header bracket by removing the rivets that attach the header bracket and roof bow reinforcement.
- remove the outer body side panel to allow access to the A-pillar reinforcement / roof rail.
- disassemble the hinge pillar to gain access to where the A-pillar reinforcement / roof rail attaches and is secured to the vehicle structure.
- remove the B-pillar.
- cut the A-pillar reinforcement / roof rail above the B-pillar joint area. The cut line identified by Ford must not be altered. Changing the location of this cut line may alter the integrity of the vehicle in future collisions and cause liability concerns.




*The replacement A-pillar is welded at the cut location above the B-pillar.*

To install the A-pillar reinforcement / roof rail:

- test-fit and tack weld the backing into the A-pillar reinforcement / roof rail sectioning joint on the vehicle.
- cut the replacement part long to allow for trimming.
- trim the A-pillar reinforcement / roof rail to length by fitting the replacement part. Trim the replacement part to allow for a 3 - 4 mm root gap for welding.
- prepare all weld and bonding areas, drill, and deburr rivet holes.
- assemble all the parts and verify dimensions are correct for the upperbody measurements.
- apply adhesive in the areas that will be rivet bonded, using caution to keep the proper distance from areas being welded.




*A weld backing is used at the cut location.*

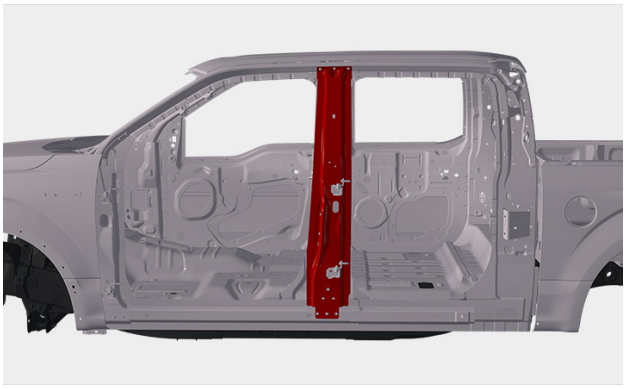
To install the A-pillar reinforcement / roof rail:

- clamp all the parts together to prepare for welding and riveting.
- place the rivets in the holes to use as guide pins. This aligns the parts during welding and riveting.
- set the rivets in the hinge pillar area.
- weld the A-pillar reinforcement sectioning joint using a stitch technique to make one complete weld.
- install the B-pillar.
- install the outer body side.
- install the upper windshield header bracket and roof assembly.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part, or on the I-CAR RTS website:

- Regular Cabs: Roof Rail
- Super Cabs: Roof Rail
- Crew Cabs: Roof Rail

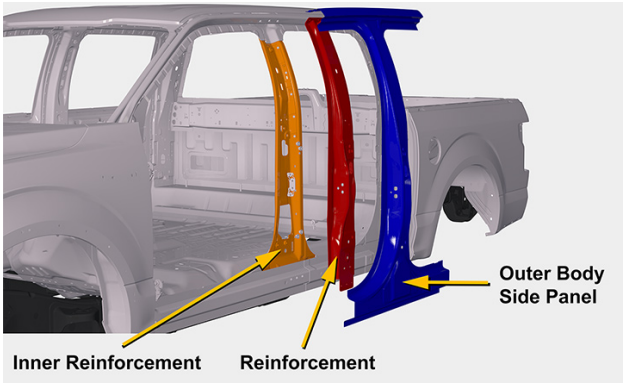
*Refer to the Video: A-Pillar Replacement in the presentation. This video discusses the processes for sectioning the A-pillar reinforcement / roof rail.*



*The B-pillar offers structural support to the upper body.*

The B-pillar assembly is:

- made from stamped 6111 aluminum alloy.
- rivet bonded together and attached to the vehicle structure with rivets.




*The B-pillar is made up of three parts.*

The B-pillar assembly:

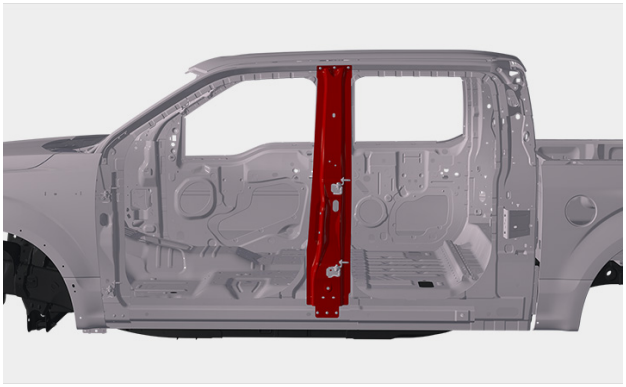
- is made from stamped aluminum parts.
- is rivet-bonded together and attached to the vehicle with rivets and welds.
- is made up of an inner, reinforcement, and outer body side panel.
- inner and reinforcement must be replaced as complete assembly, but the outer body side panel may be sectioned.

*To gain access to the B-pillar reinforcement, at least a portion of the outer body side panel must be removed.*

When removing the B-pillar reinforcement:

- straighten the body structure as necessary to remove any damage.
- cut and remove the body side panel as required to gain access to reinforcement.

Use caution to avoid damaging or thinning attachment flanges as this will compromise structural integrity and the ease of repairability.

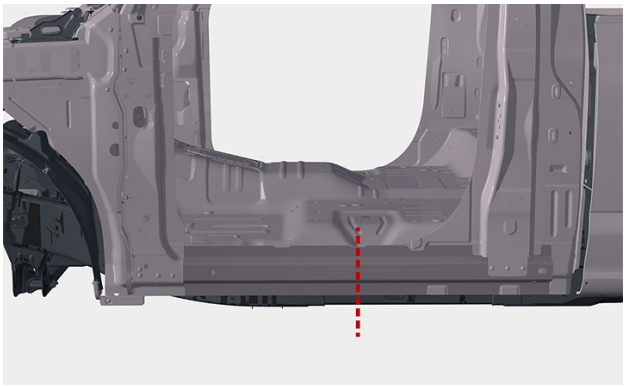


*The replacement B-pillar reinforcement is attached with rivets and adhesive.*

To install the B-pillar reinforcement:

- test-fit the B-pillar reinforcement, and prepare the rivet locations. If blind rivets will be used, 6.5 mm holes must be drilled and deburred. SPRs and solid rivets may also be used.
- clean all of the parts with wax and grease remover, and clean the bond areas with P80 sandpaper.
- apply adhesive, install reinforcement, and set rivets.

*Refer to the Video: B-Pillar Assembly Replacement in the presentation. This video discusses how the B-pillar assembly is replaced.*



*Some body styles permit sectioning of the rocker panel.*

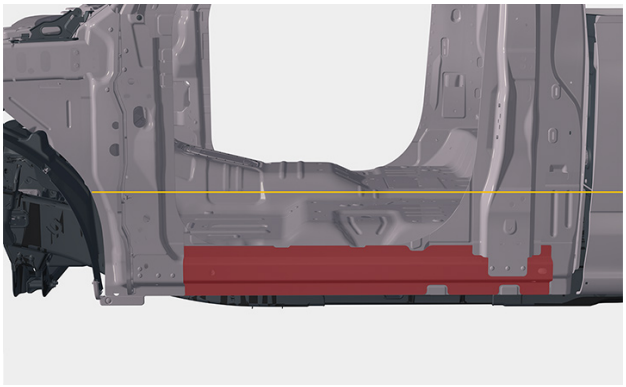
The inner and outer rocker panel on the 2015 F-150 regular cab and Super Crew is stamped from 6111 aluminum alloy.

The inner and outer rocker panel is repairable if the damage does not include a kink, tear, or crack.

**Heat may be applied, but not to exceed 425°F.**

The 2015 F-150 Super Crew:

- has an extruded rocker panel reinforcement.
- does not have a sectioning procedure for the rocker panel.



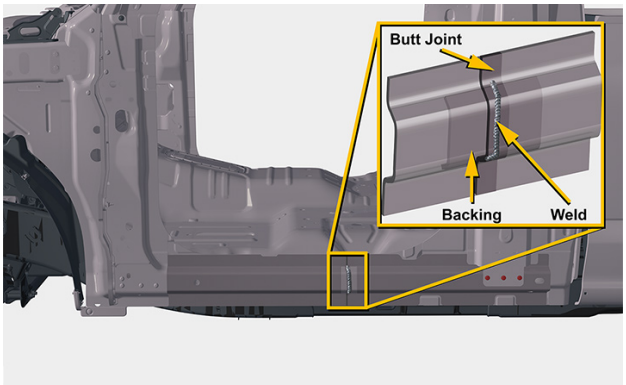
*Removing a portion of the outer body side panel will grant access to the rocker panel. The yellow line represents a possible cut location when damage is confined to the lower portion of the body.*

When removing the inner and outer rocker panel:

- cut the outer body side panel.
- remove the outer body side panel. Start this process by removing any rivets in the repair area.
- use heat to break the adhesive bond, which also helps limit damage caused by disassembly. Be mindful when using a heat gun to release the adhesive, heat may travel to other areas that are not being repaired, potentially weakening the adhesive bond.

Once the outer body side panel is removed, a determination can be made regarding installing a complete or partial rocker panel. Super Crew models will not allow for a partial replacement due to the rocker panel design.

The yellow line on the graphic represents a possible cut location on the outer body panel if the damage was confined to the lower portion of the body.



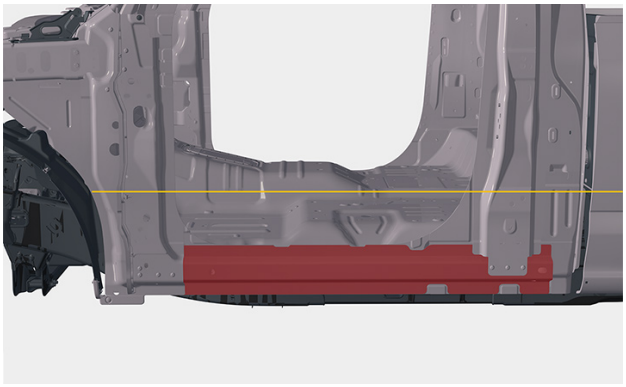

*A butt joint with backing is used for the sectioning joint.*

When sectioning the inner or outer rocker panel reinforcement:

- cut the reinforcement as per the workshop manual.
- build a 50 mm insert to use as a backing.
- cut the replacement part as per the guidelines outlined in the workshop manual.
- prepare bonded areas.
- install the backing to the reinforcement attached to the vehicle structure.
- fit the replacement part and determine the appropriate root gap.
- measure to verify proper panel placement.
- weld the repair seam and rivet bond the flanges of the replacement part.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- Regular Cab - Inner Rocker Panel, Outer Rocker Panel
- Super Cab - Inner Rocker Panel, Outer Rocker Panel
- Crew Cab - Inner Rocker Panel, Outer Rocker Panel



*The rocker panel reinforcement is shown above.*

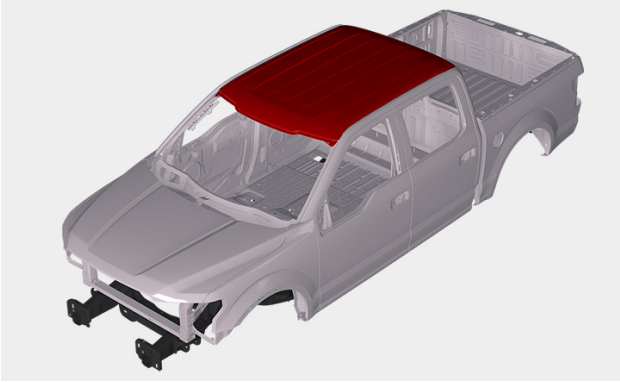
When doing a complete replacement of the inner or outer rocker panel reinforcement:

- other assemblies, such as, the hinge pillar and B-pillar may require disassembly.

- rivet bonding is used to reattach the replacement rocker panel parts to the floor pan, B-pillar, and hinge pillar.

When doing a complete part replacement, sand with P80 grit and clean all parts with wax and grease remover along with the adhesive-bonding locations.

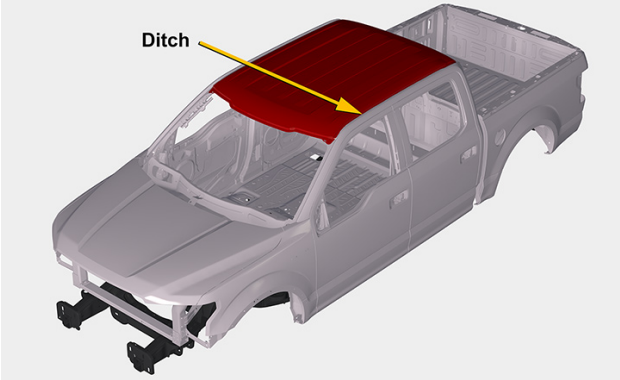
*Refer to the Video: Partial Rocker Replacement in the presentation. This video discusses how a stamped rocker panel is replaced.*



*The roof panel is attached with welds, adhesives, and rivets.*

The roof panel is:

- stamped from 6022 aluminum alloy.
- rivet bonded across the front and rear of the roof, and laser welded along the sides from the factory.
- replaced as an assembly.
- rivet bonded and bonded as an assembly during replacement.

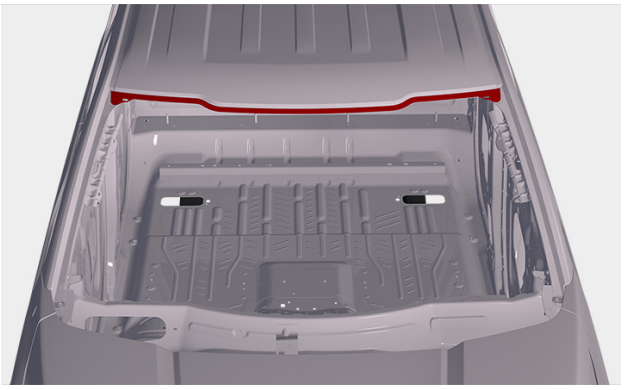



*Laser welds are carefully removed from the ditch area.*

When replacing the roof panel:

- remove the SPRs from the header panel and rear window opening area.
- remove sealer from the roof ditch.
- cut the laser welds in the ditch. These welds can be cut with a laser weld cutter or cutoff wheel.
- separate the flutter foam from the crossbows using a putty knife. If the roof bows are not damaged, leave the foam attached to the roof bows. Then use a small amount of adhesive to reattach the existing foam to the new roof panel. Do not use windshield adhesive to reattach flutter foam to a roof

panel, as contour mapping can occur during expansion and contraction.



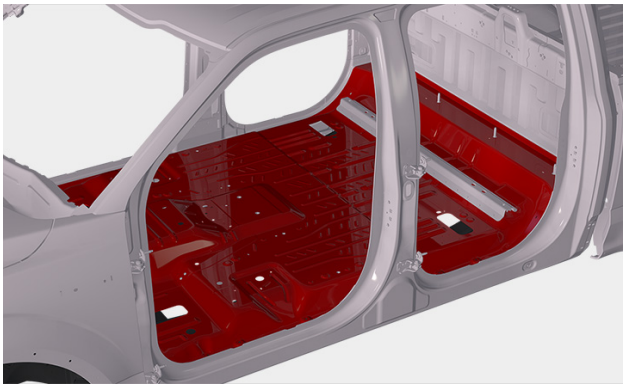
*Rivet bonding is used along the front edge of the roof.*

When installing the roof panel:

- test-fit the replacement part for proper position, and mark where holes need to be made in the replacement part if solid rivets are being used.
- prepare flanges for adhesive application.
- prepare the front and rear of the roof panel for rivets.
- clean all bonding areas and apply adhesive. When the adhesive is applied, this may also be a good time to prepare for adding the flutter foam to the areas between the roof rails and roof panel.
- apply flutter foam.
- set the roof in position and clamp.
- install the rivets. Be sure to install all the rivets into their locations and clamp the panels securely before setting the rivets.
- smooth the adhesive along the roof rails, and let the adhesive cure before applying sealer or refinishing.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part, or on the I-CAR RTS website:

- All Cabs: Front Upper Windshield Header, Roof Panel, Rear Header
- Regular Cabs: Rear Roof Panel Reinforcement
- Super Cabs: Roof Bows, Roof Center Bow K Brace

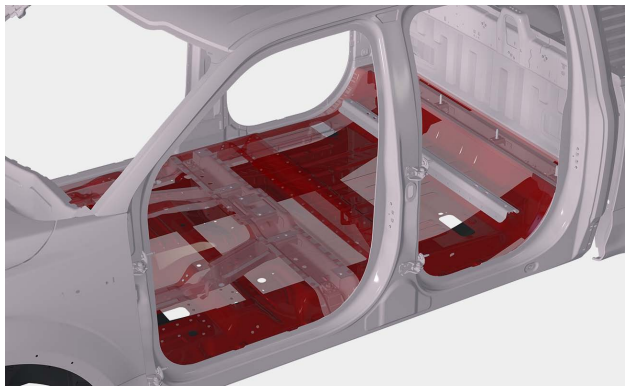


*The floor pan is a single layer stamped part.*

The floor pan is:

- stamped from 6022 aluminum alloy.
- repairable. The floor pan may be straightened, replaced as an assembly, or sectioned according to the damage.

- rivet bonded by the vehicle maker with SPRs.
- attached at the rocker panels, crossmember, rear body panel, and cowl.
- available as a complete part with or without the crossmembers attached.



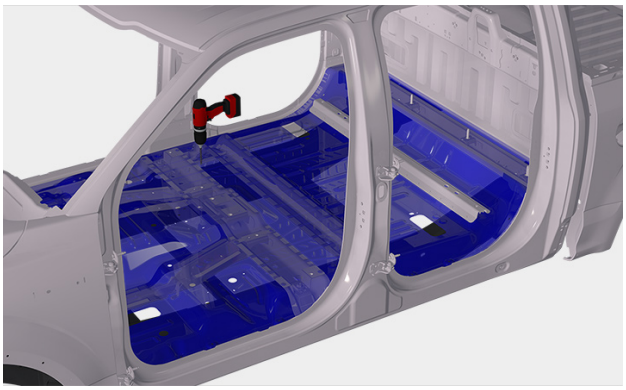
*The floor pan can be sectioned anywhere rearward of the front seats.*

A partial floor pan may be installed. When deciding how to install a partial floor pan:

- the floor pan may be sectioned depending on where the part is damaged.
- the repair area must be a minimum of 50 mm from seat mounting locations.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- All Cabs - Floor Pan Tunnel
- Regular Cab - Floor Pan
- Super Cab - Floor Pan
- Crew Cab - Floor Pan

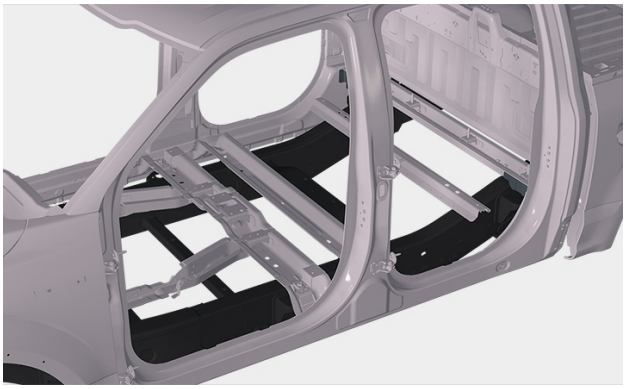


*Drill rivets carefully so the holes are not too large.*

When installing a complete floor pan:

- test-fit the new part to ensure no additional straightening is required.
- drill blind and solid rivet locations.
- clean and prepare flanges for adhesive.
- apply adhesive to all of the bonding locations.
- install rivets or clecos to hold the part in alignment.
- set the rivets before the adhesive wet time expires. When working with a large part, multiple technicians may be required to get the part fully installed before the working time of the adhesive expires.

The complete floor pan will extend to the cowl and rear body panel.

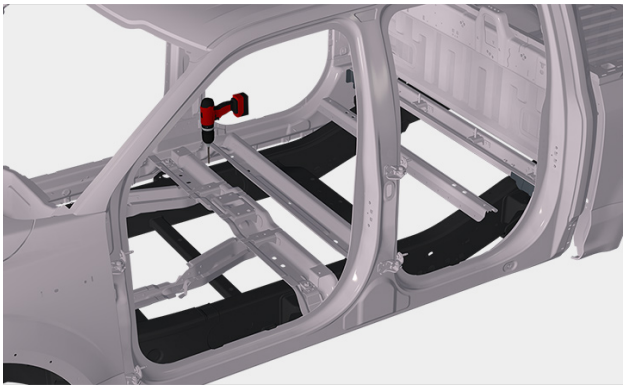


*The floor pan crossmember reinforcements may be sectioned.*

The floor crossmembers:

- are stamped from 6111 aluminum alloy.
- may be straightened. **Using heat (not exceeding 425°F) to straighten the crossmember will help in reducing the chance of the part cracking.** If the part cracks or tears, replacement is required.
- are rivet bonded to the vehicle with SPRs at the factory.
- may be sectioned.

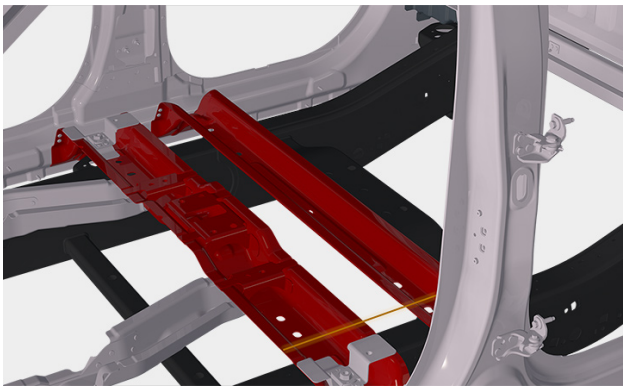
Depending on which type of cab is being repaired, there may be two or three crossmembers.



*Hemlock rivets are installed where the crossmember attaches to the inner rocker panel.*

When removing the floor crossmember:

- straighten damage from adjacent areas.
- drill out the rivets.
- use a heat gun to soften the adhesive bond between the parts. **Per Ford, using heat (not exceeding 425°F) to loosen a rivet bonded panel should only be done when all panels in the joint will be replaced or separated and new adhesive applied.**



*Sectioning through holes is not recommended by Ford.*

The floor pan crossmember can be sectioned with a butt joint with backing using welding or rivet bonding.

When sectioning the floor crossmember, cut the crossmember according to the damage. When making the sectioning cut, do not cut in highly formed areas. The recommended repair joint is a butt joint with a 100 mm backing.

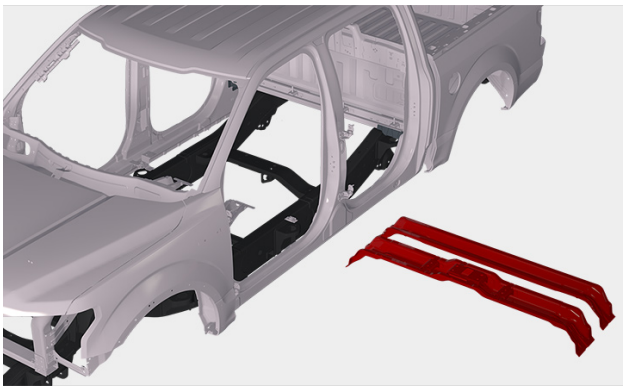
If rivets are being used at the repair joint, hemlock rivets and adhesive are recommended. Refer to the Ford workshop manual for the recommended rivet configuration. Hemlock rivets and adhesive are used to attach the crossmember to the inner rocker panel. Hemlock rivets are installed one for one for each SPR that was used by the vehicle maker. Hemlock rivets and adhesive are used to attach the floor to the crossmember.

When sectioning the floor pan crossmember using rivets:

- test-fit the replacement part to fit flush against the existing crossmember.
- prepare the bonding areas and apply adhesive.
- install the backing plate into the vehicle side of the crossmember and install the rivets.
- secure replacement part with clamps or clecos.
- install the rivets.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- All Cabs - Front Floor Crossmember, Center Floor Crossmember, Rear Floor Crossmember
- Super Cab - #3 Rear Floor Crossmember, Rear Seat Floor Crossmember
- Crew Cab - #3 Rear Floor Crossmember, Rear Seat Floor Crossmember



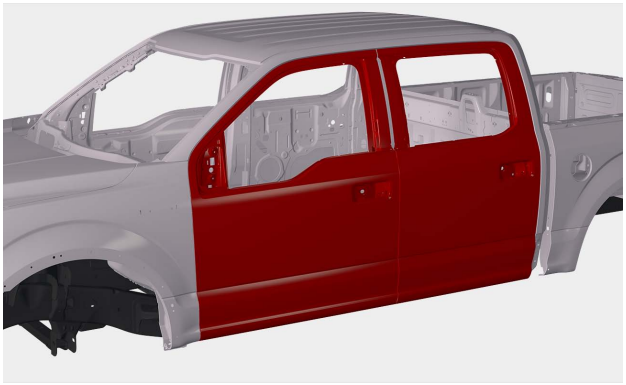
*Complete floor pan crossmember replacement is a viable repair option.*

When installing a new complete floor crossmember:

- remove the damaged part without causing damage to other parts of the vehicle.
- follow Ford's recommendations for proper rivet selection and placement.
- prepare the bonding areas.

- test-fit the part, drill rivet holes, and debur.
- apply adhesive to both flanges.
- make sure it is properly aligned, securing it with clamps or clecos.
- install the rivets and let the adhesive cure.

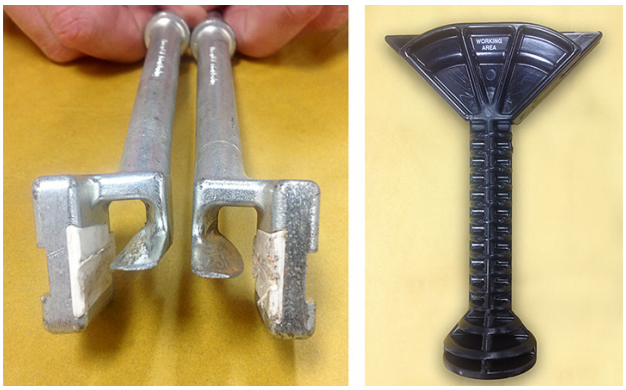
*Refer to the Video: Floor Pan Crossmember Sectioning in the presentation. This video discusses how a floor pan crossmember can be sectioned if it is damaged.*



*The door panel / skin is available as a service part.*

The door panel / skin is:

- a stamped part made from 6022 aluminum alloy.
- available as a service part that can be replaced separate from the door shell.
- attached to the door shell using a rope hem flange.



*Special tools for working with the door panel / skin include a tool that will open a hemmed seam (left), and a tool that aids in creating a rope hem flange (right).*

To replace a door panel / skin:

- remove the damaged panel / skin using a grinding disc or the special door panel / skin removal tool.
- remove the adhesive and clean the door frame flange using abrasives no coarser than P80 grit to bare aluminum.
- straighten the mating flange.
- scuff the door panel / skin mating flange.
- clean the bonding areas with wax and grease remover.
- apply adhesive to both the door skin and the door frame.
- clamp the door panel / skin into position.
- create a rope hem flange to keep the aluminum from cracking by gradually rolling the flange

into position. Avoid hammering the flange flat. There are also hemming tools available that will help with hemming the flange.
- spread the remaining adhesive to help seal the joint.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- All Cabs - Front Door Outer Panel
- Crew Cab (CC) - Rear Door Outer Panel (CC)

*Refer to Video: Replacing A Door Skin Using Rope Hem Flange in the presentation to see a video that shows how to replace a door skin using a rope hem flange.*

*The rear cab panel is able to be replaced without damaging adjacent panels.*

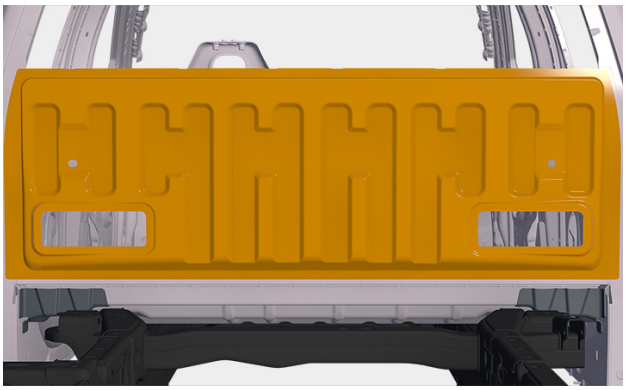
The rear cab panel is:

- a stamped part made from 6022 aluminum alloy.
- repairable. The rear cab panel may be repaired cold or with the use of heat.
- rivet bonded. For new vehicle assembly, SPRs are used. For part replacement, solid rivets or SPRs are more cosmetically acceptable than hemlock rivets for the upper part of the panel. At areas below the bedline, hemlocks may be used because they are not easily seen.
- able to be replaced without damaging adjacent panels.

*The rear cab panel is rivet bonded to the cab.*

When removing the rear cab panel:

- remove the box to allow access to the rivets.
- straighten the cab assembly as needed.
- remove SPRs and the damaged panel.
- clean the existing flange of adhesive residue with P80 grit sandpaper, and straighten as needed.



*Hemlocks and solid rivets, along with adhesive, are used to attach the rear cab panel.*

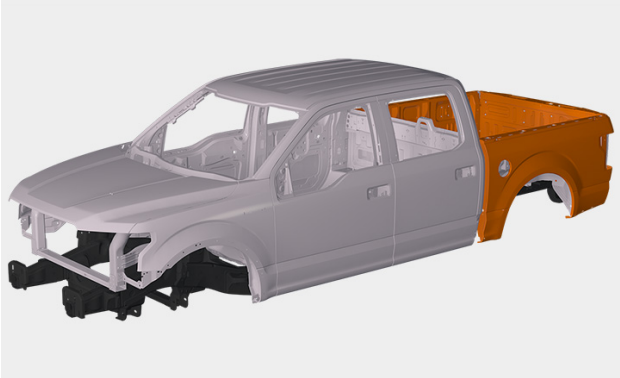
When installing the rear cab panel:

- test-fit new part for proper placement.
- mark and prepare it for rivet installation. Note that if SPRs are being used, no holes are required. If using solid or blind rivets, drill the proper size hole.
- remove coatings down to bare metal on the mating flange of the replacement part.
- remove adhesives and coatings from the vehicle mating flange with abrasives no coarser than P80 grit. Clean the flanges with wax and grease remover.
- apply adhesive to both panel flanges.
- use rivets or clecos as guide pins to position the panel, then clamp it in place.
- set the rivets and allow the adhesive to cure.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- Back Panel and Reinforcements

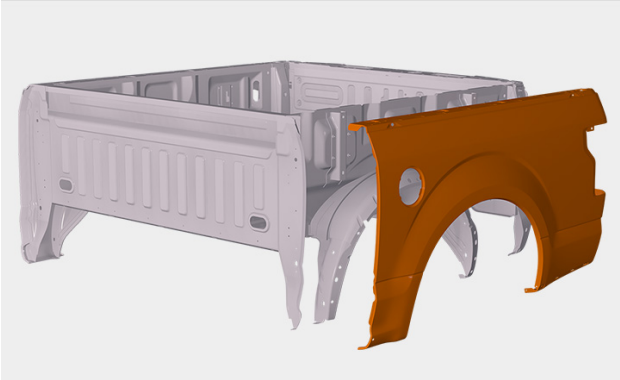
**Box Assembly**



*The box assembly is aluminum intensive.*

Like the cab, the box assembly is made of stamped parts that are rivet bonded together. The floor is spot welded to the bed floor crossmembers.

Depending on the severity of damage, various service parts are available to repair the box assembly.



*The outer side panel is available as a service part and replaced with rivet bonding.*

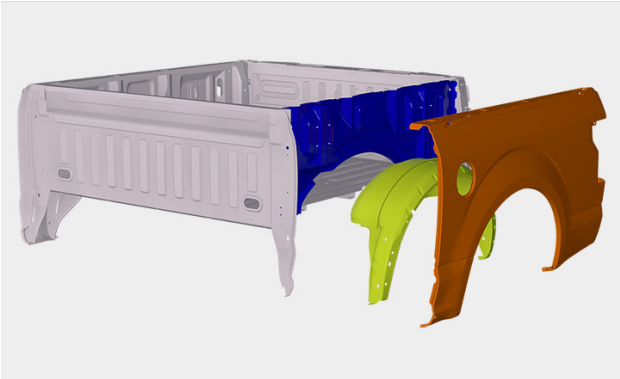
When removing the outer box side panel, remove the box to allow access to the rivets.

When installing the outer box side:

- straighten flanges as needed.
- test-fit it for proper placement.
- mark and prepare it for rivet installation. Note that if SPRs are being used, no holes are required. If using solid or blind rivets, drill the proper size hole.
- prepare the mating flanges.
- apply adhesive to both panel flanges.
- use rivets or clecos as guide pins to position the part, then clamp in place.
- set the rivets and allow the adhesive to cure.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- Outer Box Side- All Sizes
- Front Panel
- Box Rear Corner
- Box Wheel House



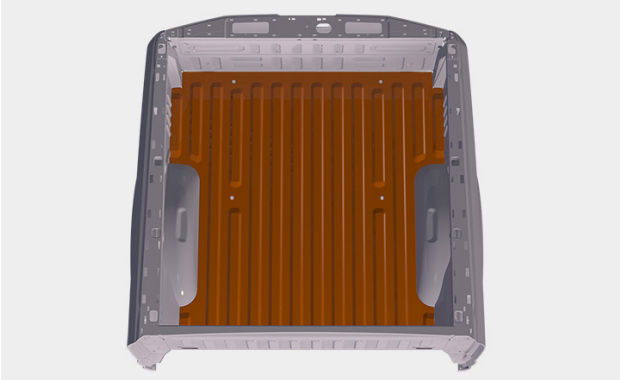
*The inner box side is available as a stand-alone part.*

When working on the inner box side, the inner:

- wheelhouse and inner box side are available as service parts.
- box side is replaced with similar procedures as the outer box side.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- Inner Box Side - All Sizes



*The bed floor is available with the underside crossmembers attached.*

The bed floor is attached to the crossmembers with spot welds, but the bed floor attaches to the boxsides with SPRs. The bed floor may have minor damage removed, or the entire floor can be replaced. The bed floor is available as a service part with the crossmembers already installed.

For more information on this procedure visit Motorcraft's website. Refer to the Ford Service instructions that are available with the part or on the I-CAR RTS website:

- Bed Floor- All Sizes

**Refinishing Aluminum Parts**

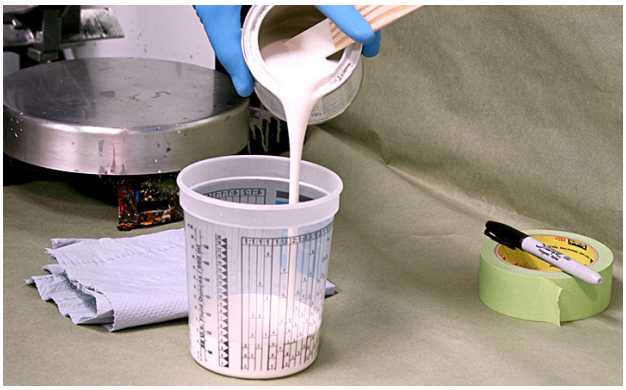
*Follow the refinishing steps provided by a Ford-approved refinishing system.*

When refinishing parts for this vehicle:

- avoid fallout from steel particles. Even if covered by refinish materials, steel contamination will cause corrosion and bubbling of the finish.
- if tools that are used on steel vehicles are being used on an aluminum vehicle, keep them wiped off and clean. Cross-contamination is a major concern and will lead to galvanic corrosion. After the parts have been prepared for refinishing, follow the refinishing recommendations outlined by the

product maker. Do not intermix refinishing systems, and be sure to use products that are compatible with aluminum.

When refinishing aluminum parts, refer to the paint maker's technical data sheets for the correct materials and processes.

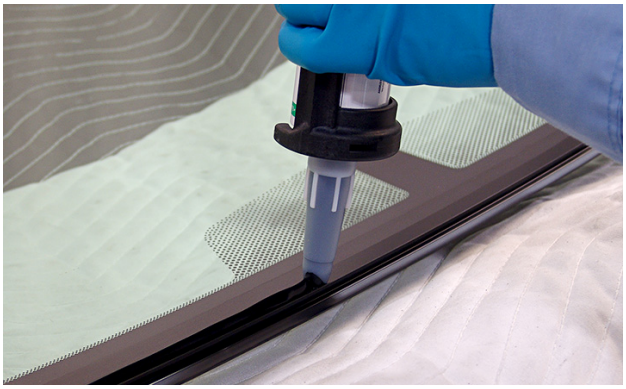


*Always follow the paint maker's recommendations.*

When preparing a new part for refinishing:

- clean the part using soap and water followed by a wax and grease remover.
- scuff the E-coat with the appropriate sandpaper. Do not break through the E-coat. If the E-coat is removed, cover the exposed metal with an approved primer.
- clean the part again with a wax and grease remover.
- apply primer or sealer as required.
- apply basecoat / clearcoat according to the refinishing system recommended by Ford.

**Stationary Glass Installation**



*Be sure to use the correct size adhesive bead when installing stationary glass.*

When installing the windshield:

- bare metal flanges need to be primed as required.
- use approved glass urethane adhesive, Dow BETASEAL Expess urethane. Nonconductive glass urethane adhesive may be used but it is not required.
- a primer may be required. Some glass adhesives require a primer to be used on the bare glass.
- duplicate the factory urethane height. Ensure that the urethane bead width and height will closely duplicate what was done at the factory.

Foam-core butyl tape is used around the perimeter of the backglass. Ensure where the foam-core butyl tape is used, there is no bare aluminum. The finish will work as an insulator between the aluminum and butyl tape.

Being that the backglass is not structural, the backglass is held in place with threaded fasteners and:

- it is allowable to refinish the areas where the backglass will attach.
- foam-core butyl tape is used to seal out wind and rain.

*When trimming the existing adhesive bed, do not cut down to the bare metal.*

Follow the glass adhesive maker's recommendations and steps when installing stationary glass.

After applying epoxy primer to the windshield pinchweld flange, mask the flange to keep basecoat / clearcoat from contacting the epoxy primer surface.

**Module Wrap Up**

Topics discussed in this module included:

- what materials are used at different locations on the vehicle.
- what repairs can be done to the magnesium radiator core support.
- how close to a hinge or striker a cut line can be for repairs.
- the repair process for the laminated dash panel.
- the repair process for the extruded rocker.
- what type of windshield adhesive is required for stationary glass installation on aluminum vehicles.

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# Module 5 - Frame Repairs

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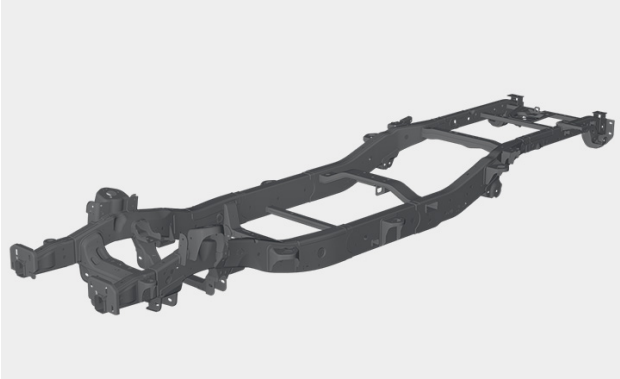
## General Design And Construction

Learning objectives for this module include:

- describing what steel strengths are used in the frame.
- explaining what frame repairs are supported by Ford.



*The frame used on the 2015 F-150 looks similar to the frame used on the 2014 F-150.*

The frame on the 2015 F-150:

- is made from HSLA550 steel.
- is not repairable if cracked. Cracks in 2004 to current F-150s cannot be repaired because the frame is a hydroformed design and does not allow access to the backside. For this reason, cracks are not repairable. If a part on the frame is cracked, replace that portion of the frame.
- has many servicable brackets.

Refer to the Ford Steel Repairability Matrix for heating information.

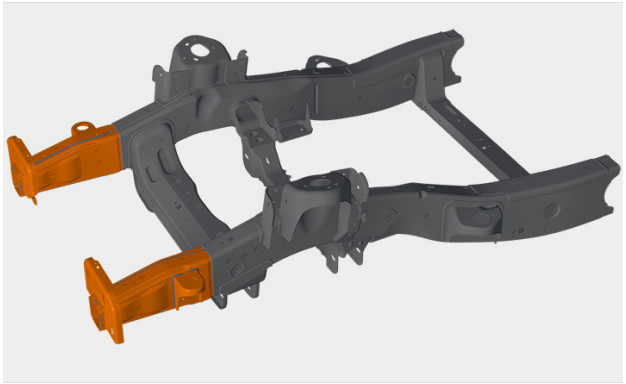
There are crack repair procedures for the Super Duty.

**Vehicle Maker Note**
Ford provides instructions with their service parts.


*When doing frame repairs, use a welding machine that is capable of producing enough amperage for the thickness of steel being welded.*

For welding on the 2015 F-150 frame, use ER70S-6, .035 diameter electrode wire.

There is no specific brand of welding machine required, however, Ford recommends a welding machine capable of at least 200 amps. Test welds should be done to verify adequate penetration of the weld.



*The front stub is one of the three major parts that can be replaced on the 2015 F-150 frame.*

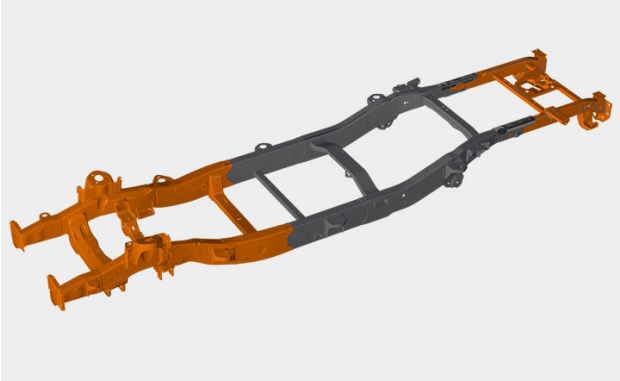
The front frame stub is:

- replaced at the factory seam behind the cooling pack.
- installed as supplied with a tapered lap joint.
- attached with a fillet weld.

*Front control arm brackets are a service part on the 2015 F-150.*

The front control arm brackets are offered as a replacement part. The rear control arm brackets are not available as a replacement part.

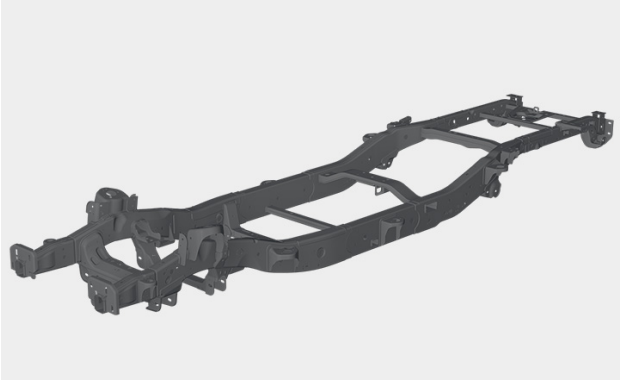
On previous model Ford truck frames, there were no replacement control arm brackets offered. As model years change, more frame parts are becoming available as service parts.



*Front and rear frame sections make the frame more repairable than some previous model F-150s.*

The front and rear frame sections:

- are replaced the same as the previous model, at the factory joints.
- slide into the center assembly of the frame.



*Refer to Module 5, Demonstration: Frame Repair Guidelines in the presentation for a visual example of the:*

- *vehicle frame.*
- *front control arm bracket location.*
- *front frame assembly location, and attachment location.*

- *front frame tip location.*
- *rear frame assembly location and attachment location.*

**Module Wrap Up**

Topics discussed in this module included:

- steel strengths used in the frame.
- frame repairs supported by Ford.

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