General InformationBody Repair, Body Collision Repair

Edition 06.2017

Repair Group

Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

Contents

1 Safety Precautions

(Edition 06.2017)

1.1 Fuel Tank or Fuel-Carrying Lines

Extreme caution is necessary when sanding and welding around the fuel tank or other fuel-carrying components. If in doubt, such components must be removed.

The BG rules (BGR 157) must be followed for vehicles with natural gas fuel tanks.

1.2 A/C System / Refrigerant

Never weld or hard/soft solder components of a filled A/C system. This also applies to welding and soldering on the vehicle, if there is a risk that it may heat up components in the A/C system. When performing paint repairs, objects in the drying oven or its pre-warming area may only reach 80 °C (176 °F). This is because warming causes high pressure to develop in the pressure relief valve on the A/C compressor.

Note

Coolant systems must also be extracted if electrical welding will take place around coolant lines. When welding electrically, invisible ultraviolet rays are released that penetrate the coolant hoses and damage the coolant.

1.2.1 Corrective Measure:

Evacuate the refrigerant circuit. Refer to ⇒ Heating, Ventilation and Air Conditioning; Rep. Gr. 87 ; Heating and A/C System

1.3 Electronic Control Modules

Connect electric welder ground (GND) connector directly to the piece to be welded. When doing so, be careful that there are no electrically insolated parts located between the ground connection and the welding location.

Do not touch electronic control modules and electrical wires with the ground connection or welding electrode.

Replacing electronic control modules after a collision is then only required if at least one of the following conditions is met:

- The housing is distinguishably deformed or damaged.
- The contact surface or bracket is deformed; the device shows no damage on the outside.
- The connector is damaged or corroded by moisture.
- The function test or OBD of the device shows the fault: “Control module faulty”.

If electronic components, for example the ABS control modules, are removed for repair work and then reinstalled, then the existing data must be checked for function after assembly using OBD, for example.

1.4 Battery, Voltage Supply

Note

Make sure the radio code is available before disconnecting the battery. Before giving the vehicle to the customer, enter the correct code number to make the radio ready to play.

Before welding, you must remove both battery terminal clamps and cover both battery terminals.

You must remove the vehicle battery before performing work near the battery that could produce sparks.

WARNING

Follow the vehicle-specific instructions in the repair manual before connecting the battery.

Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Battery; Battery, Disconnecting and Connecting .

1.5 High-Voltage Components / Electric Vehicles

DANGER!

Work on high-voltage components and electric vehicles may only be done by properly trained and qualified personnel.

Refer to the information in the vehicle-specific repair manuals. Refer to ⇒ Electric Drive; Rep. Gr. 00 ; Safety Precautions

1.6 Natural Gas Vehicles

DANGER!

Work on natural gas vehicles may only be performed by properly trained and qualified personnel.

Information can be found in the vehicle-specific repair manuals. Refer to ⇒ Engine; Rep. Gr. 00 ; Natural Gas Engine; General Information; Safety Precautions

2 Body Repair General Information

When repairing, the original joint should always be restored.

Standard repairs are described in the repair manual. Further descriptions are not given because if there are more extensive repairs, the damaged area should be removed at the original joint. Where this is possible, the joining techniques can be implemented according to the preceding comparison.

All repairs with special separating cuts and joining techniques that do not correspond to the original joint (production status) are checked and approved by the technical development team by evaluating, strength testing and crash testing.

2.1 Original Joint

“Original joint” refers to a connection that was created by the vehicle manufacturer.

These connections should be reconstructed when performing body repairs.

When doing so, ensure that the production number of weld points does not fall short when making repairs.

Methods and procedures differing from the original connection are described in the applicable body repair manual.

2.2 Galvanized Body Parts

Fully galvanized body parts enable a high level of corrosion protection in body. To maintain the warranty against perforation corrosion even if a repair is required, then the procedures in chapter must be followed precisely.

WARNING

Because toxic zinc oxide develops in welding emissions when welding zinc-coated sheet steel panels, there must be sufficient workplace ventilation and exhaust gas removal through suitable means, for example, Welding Emission Exhaust System - VAG1586 A- .

2.3 Remaining Material, Removing

If the damaged body part is cut out roughly, for example using a body saw, based on the separation cuts in the corresponding repair manual, then have most of the spot-welded bonded joints drilled out with the spot weld breaker.

In addition, we recommend the degree sander as well as an angle grinder to remove the weld connections that cannot be removed with the spot weld breaker.

2.4 New Parts

New parts that are no longer accessible after the repair, for example the side sill, should have corrosion protection installed on

them before welding for corrosion protection reasons. It is advisable to cover the welding flange when doing so.

Additional information can be found in the paint manual.

Check new replacement parts, such as doors, panels or fenders for transport damage before sending to paint shop. This prevents double painting, if transport or accident damage to the vehicle is noticed during assembly.

2.5 Molded Foam Parts

⇒ “2.5.1 Prerequisites”, page 4

⇒ “2.5.2 Molded Foam Part, Replacing”, page 4

The molded parts are installed in the body shell and increase in volume after priming them in the paint drying-oven from approximately 180 °C (356 °F).

When using molded foam parts, proceed as follows:

- Remove any remaining foam from the vehicle.
- Create the paint construction according to the paint manual.

2.5.1 Prerequisites

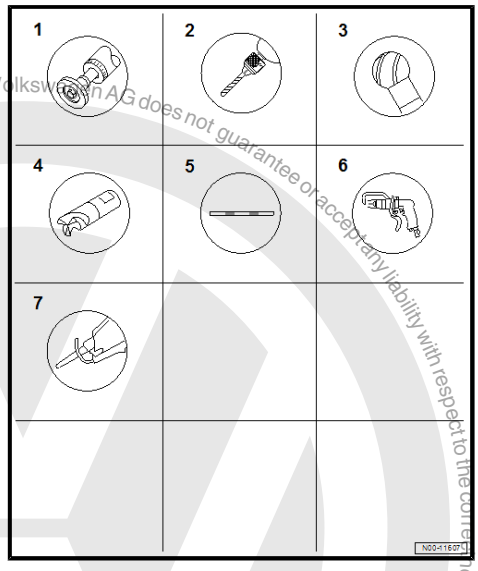
Before inserting a molded foam part, the metal part to be replaced must be prepared so that it is ready for installation, for example, cutting, fitting, corrosion protection measures.

2.5.2 Molded Foam Part, Replacing

- Cover the molded foam part all around with butyl sealing cord or two-part filler foam.
- Secure the molded foam part on the vehicle.
- Secure the new part (for example, A-pillar) while gently pressing on it around the molded foam part until it makes contact and then weld it in.
- Do not perform gas-shielded welding within at least 40 mm next to the molded foam part (on both sides)
- After painting the vehicle, seal the cavities in the repair area.

3 Explanation of Symbols

3.1 Symbols for Removing Components



1 - Grinding / Grinding down to bare surface

2 - Drilling

3 - Ball nose end mill

4 - BTR milling

5 - Separation Cut

6 - Removing weld point

7 - Sawing

3.2 Symbols for Welding and Soldering

1 - Stitch Weld Seam

2 - Gas-shielded arc plug weld

3 - Gas-shielded arc continuous weld seam

4 - Gas-shielded arc continuous weld seam (staggered)

5 - Brazing

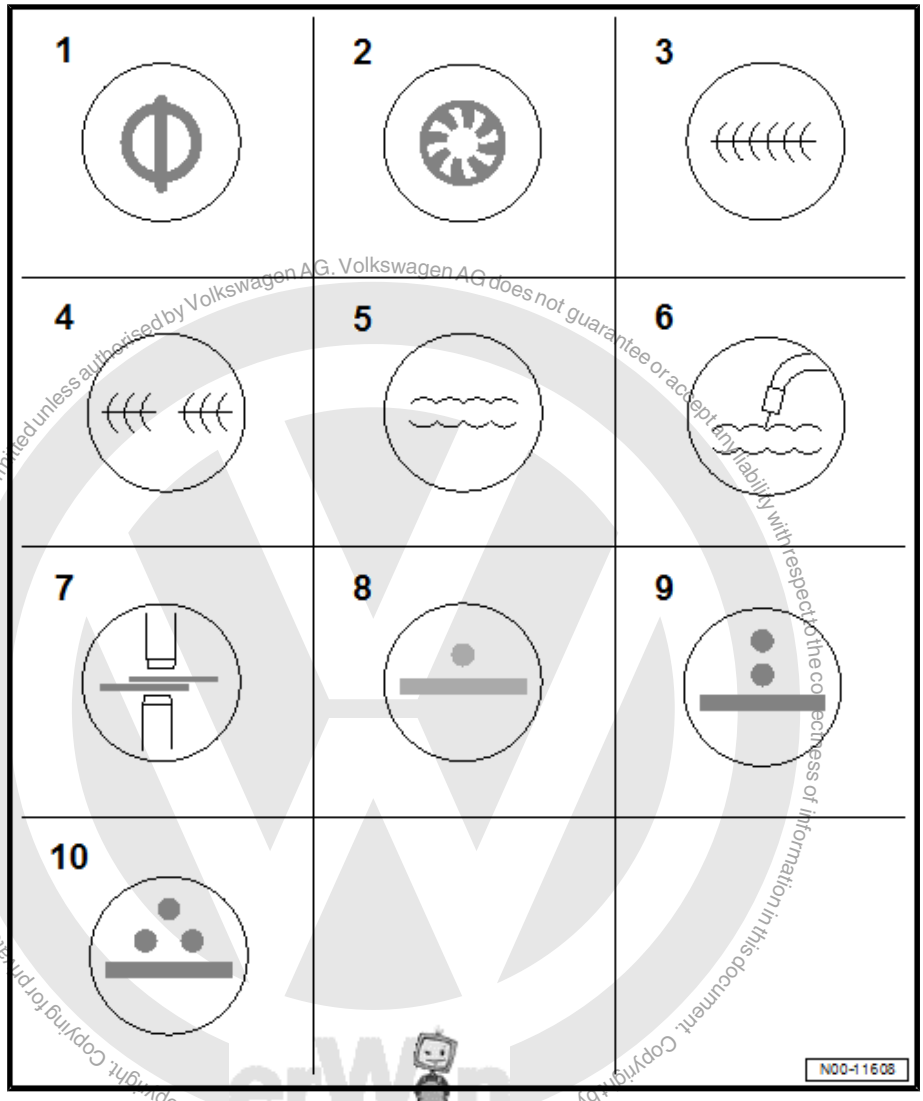
6 - MIG brazing

7 - Resistance spot welding general

8 - Straight-line spot weld (single row)

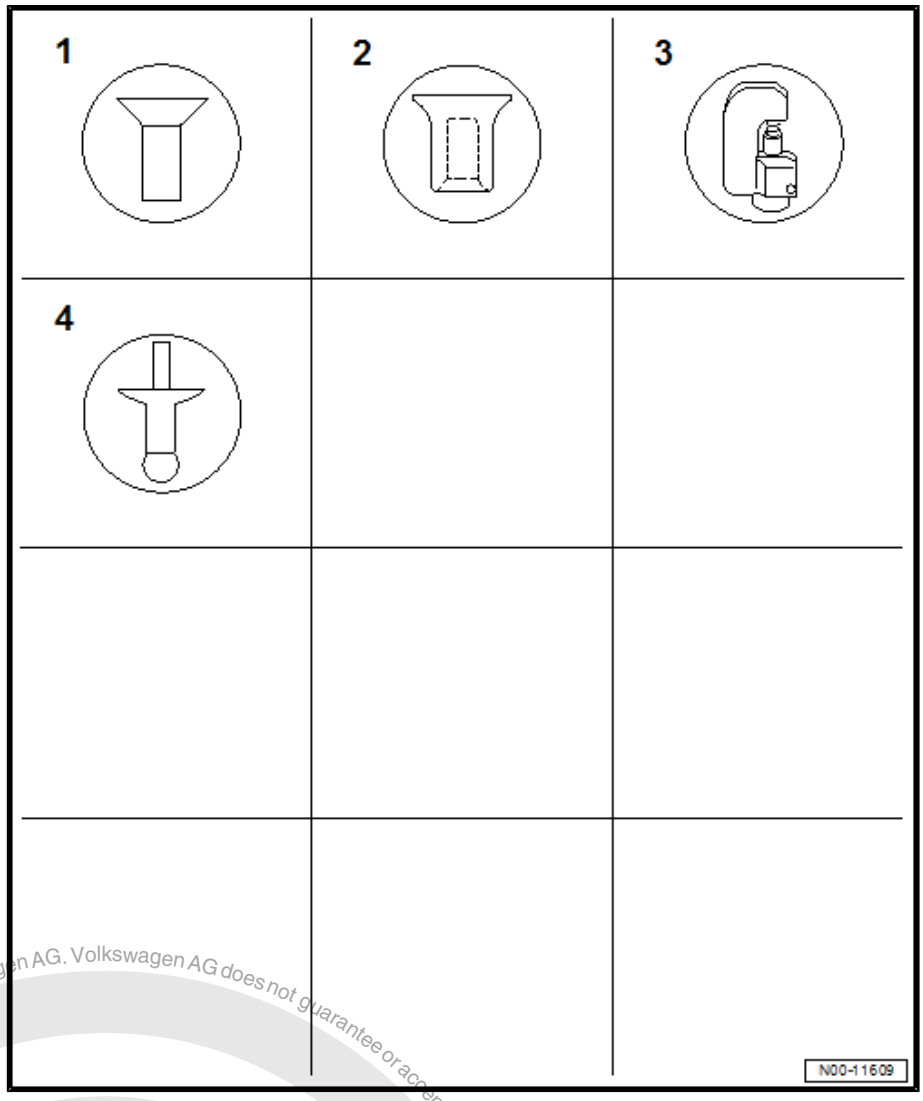
9 - Straight-line spot weld (double row)

10 - Straight-line spot weld (double row, staggered)



3.3 Symbols for Rivets

1 - Solid Rivet
2 - Punch rivet
3 - Use rivet pliers
4 - Pop Rivet



3.4 Symbols for Preparation

1 - Clamping

2 - Setting

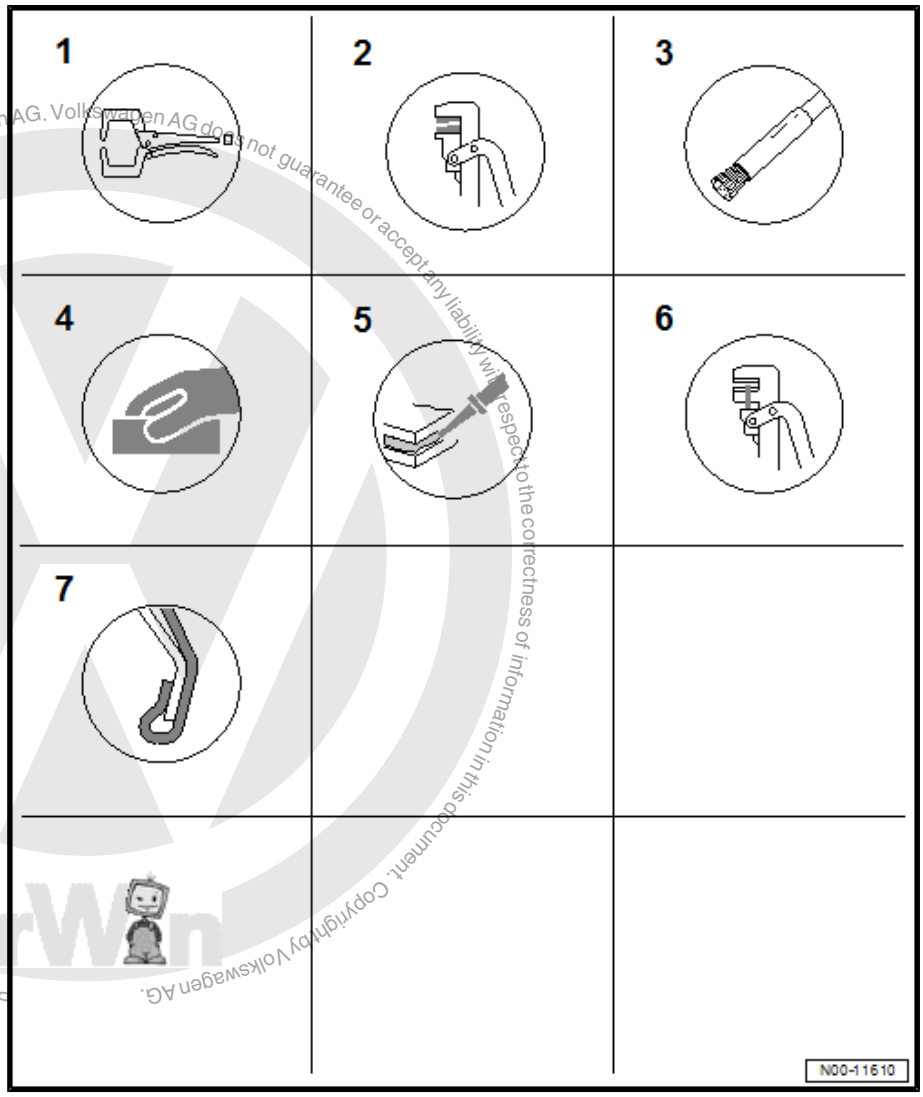
3 - Removing paint on hard-to-reach areas

4 - Sanding by hand

5 - Applying adhesive

6 - Setting

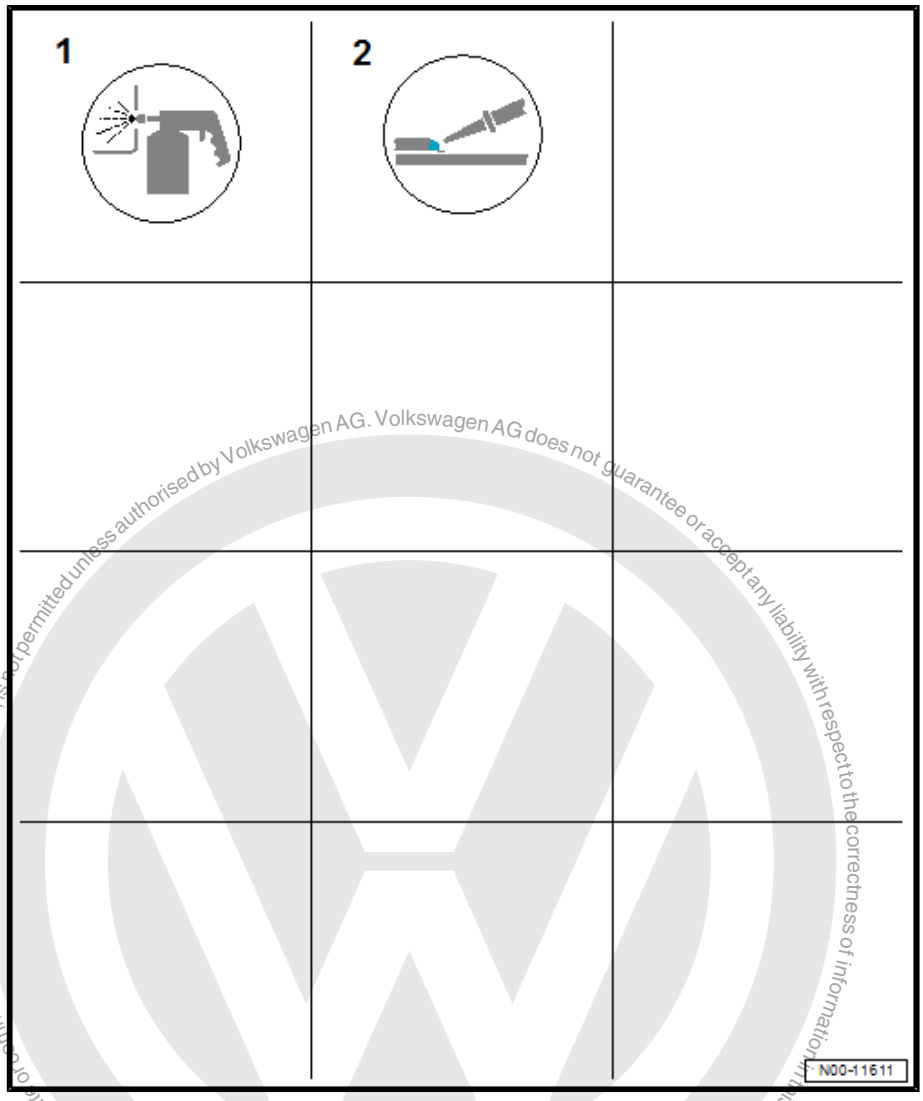
7 - Flanging



3.5 Symbols for Corrosion Protection

1 - Sealing Cavities

2 - Sealing



4 Construction Characteristics of Vehicle Body

4.1 Multi-Material Mix

In addition to the traditionally pure steel body, there is an increase in mixed-material body construction. This means that a combination of various materials are being used together.

The most common materials in modern vehicle bodies are:

- Steel (in varying strengths)
- Aluminum
- Magnesium
- Plastics
- Fiber-reinforced plastic
- Carbon fiber materials

4.2 Types of Body Construction

In addition to the familiar unitary vehicle body, other types of body construction are used in Volkswagen Group vehicles.

4.2.1 Aluminum Spaceframe

The unique characteristic of the spaceframe body is that it has a supporting frame construction made from aluminum, which ensures the stiffness of the body. Body shell components, such as roofs or fenders, also assist in this, but they generally do not have a supporting function (for example, Audi R8).

4.2.2 Body-On-Frame, VW Amarok

Vehicles with body-on-frame construction generally have a supporting ladder frame construction that carries the engine, suspension and body. This type of construction is primarily used in commercial vehicles and off-road vehicles.

5 Damage, Evaluating

5.1 General Information

When repairing vehicles involved in collisions, damage to the body or suspension is not discovered. In some cases, this may cause serious subsequent damage later. In accidents that indicate a heavy load on the vehicle, the following components must be checked - regardless of whether or not the axles were already checked:

- Check steering and steering linkages using steering wheel angle for problem-free function, visual inspection for bends or cracks.
- Check suspension, all suspension parts such as control arm, suspension struts, steering knuckle, stabilizer bar, subframe, axle beam and their fasteners for bends or cracks.
- Check rims and tires for damage, run-out and imbalance. Check tires for cuts in the tread and the sides and check the tire pressure.
- Check mounts for engine, transmission, axles and exhaust system for damage.
- Finally, a proper road test after repairs ensures that the vehicle is safe to drive and can be handed over to the customer.

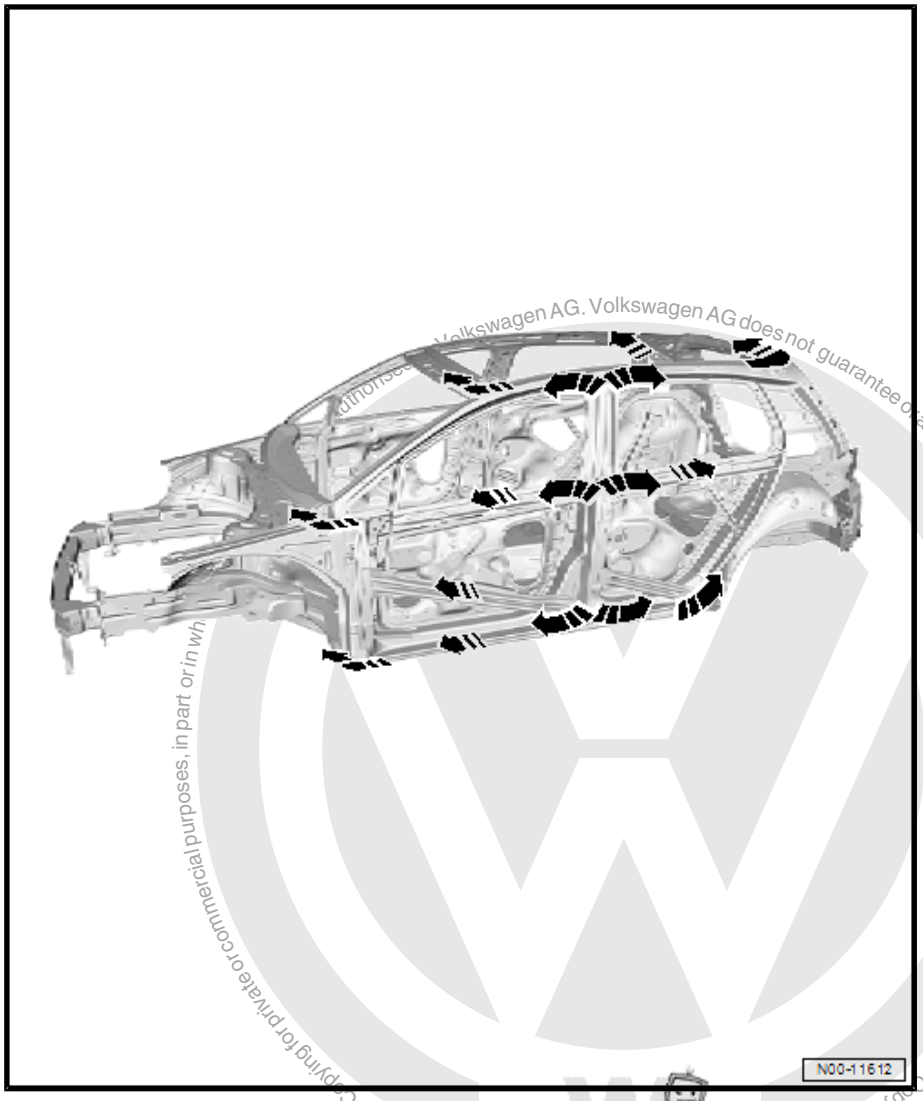
5.2 Weld Seams and Cast Joints, Checking

The color penetration process is used to test for surface cracks. Use the approved repair materials for this.

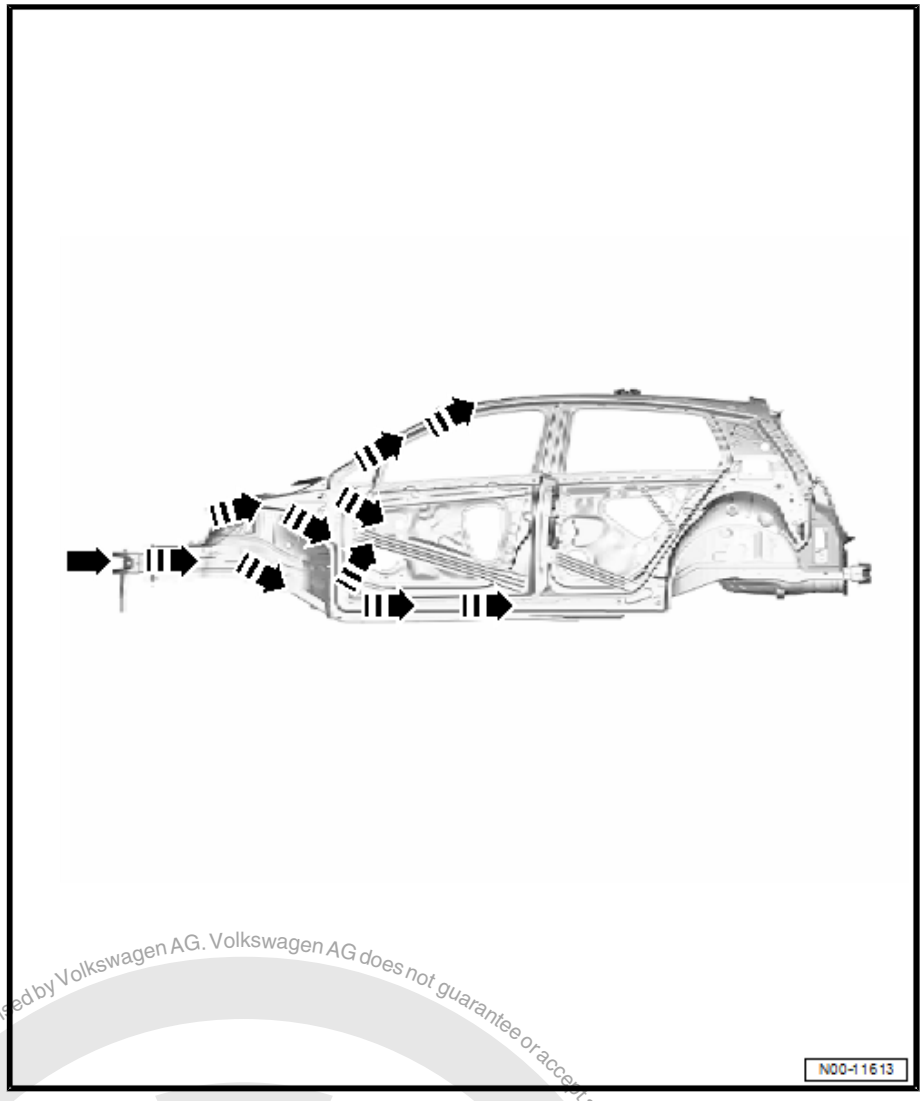
Note

Do not brush the area to be checked before the test; otherwise, the cracks will be smeared.

5.3 Load Paths



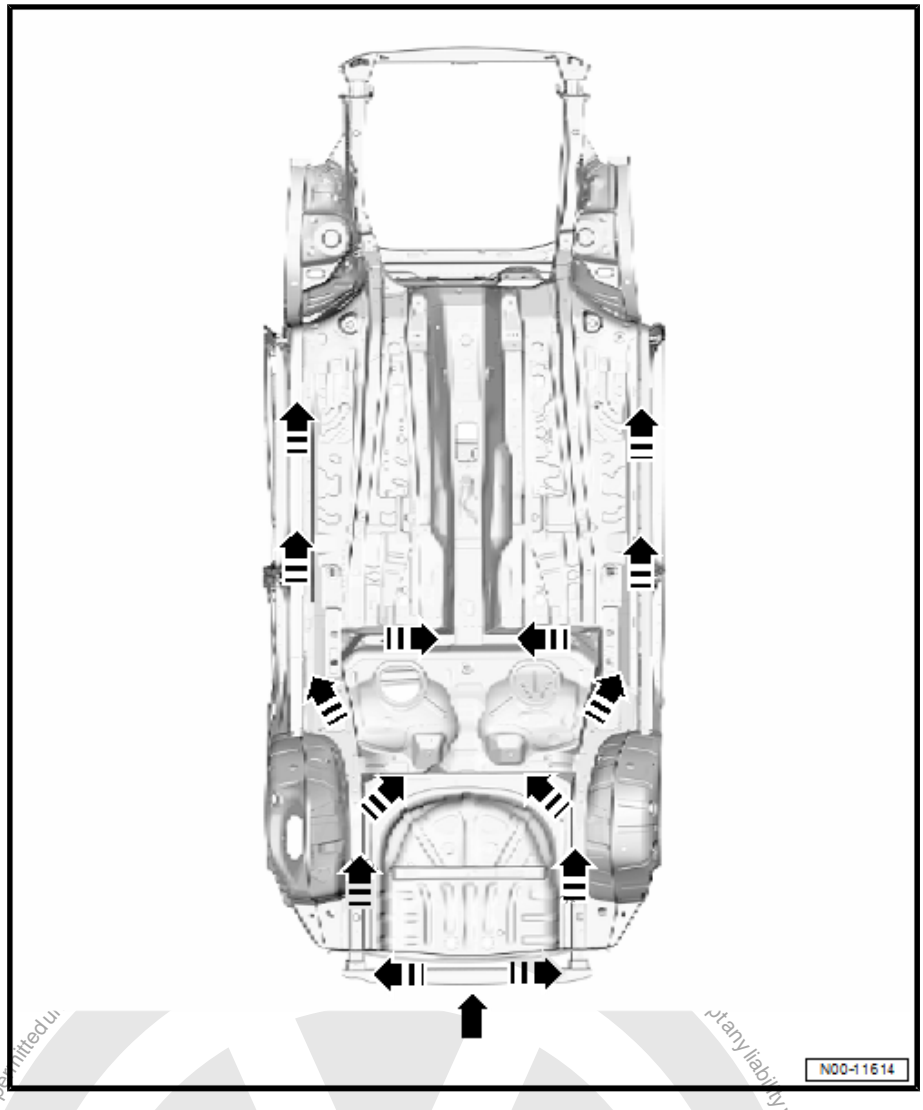
The image above illustrates how the energy is transferred around the passenger compartment during a side impact. When evaluating the damage, particular attention should be paid to the door side impact protection, as well as the A- and B-pillar connection to the sill and roof frame.



The goal of the body design is for the front of the vehicle body to absorb as much of the energy as possible.

If there is heavy damage to the front of the vehicle structure, the A-pillar transition area to the roof frame or sill must also be closely inspected during the damage evaluation.

Due to the structure, the entire outer shell should also be inspected, since elastic deformations in the high-rigidity structure may cause plastic deformations in the outer shell.



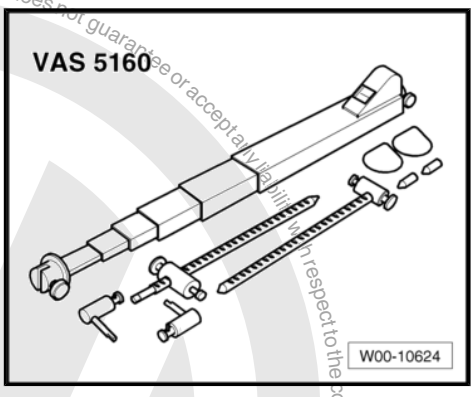
When evaluating damage in the rear, carefully inspect to see if there is any metal distortion in the luggage compartment floor area. Due to the spring effect of the materials used, there may be damage, even though the longitudinal members do not indicate any deviation in dimension.

5.4 Measuring / Damage Diagnosis

- Information on approved measuring devices can be found in the Electronic Parts Catalog (ETKA).
- For information on body and gap dimensions, refer to the vehicle-specific repair manual.

Refer to ⇒ Body Repair; Rep. Gr. 00 ; 00; Technical Data .

Telescoping Gauge



Note

To quickly diagnose accident damage, it is often sufficient to perform a diagonal comparison measurement using a telescoping gauge.

5.5 Overview of Materials Used

5.5.1 Important Notes for Deep-Drawn Steel

Body and floor assembly in series production are produced predominantly from cold-formed deep-drawing sheet metal. For this reason, reshaping accident damage should be carried out in the same way. If the size of the damage does not allow it to be reshaped against the direction of damage, the damaged part must be removed after straightening the connecting surfaces.

5.5.2 Important Notes for High-Strength and Ultra-High-Strength Steel

High-strength steel panels are being used increasingly in our vehicles. You can see the areas where these panels are used in an image in the body repair manual. Refer to ⇒ Rep. Gr. 00 .

What are high-strength panels?

Optically normal panels, but they have a higher yield point than normal body panels because of various alloys. This means, with the same force applied to the panel, the dent in the high-strength panel is not as deep as that in a normal body panel.

What must be observed when removing dents?

Dents are removed with standard tools. Due to the higher dent resistance, there is greater rebound so that it may be necessary to expend more force. When buckled areas are reshaped, breaks in the material may occur.

What must be observed when straightening with a bench-type straightening system or hydraulic press?

Due to the greater rebound characteristics of high-strength panels, it must be stretched more than a normal panel before it remains in the desired position. Due to the higher application of force, normal panels that are welded with high-strength panels are strained more. In order to prevent normal panels from yielding or tearing, an additional anchorage must be provided.

WARNING

- *If a high-strength panel is stretched too much, it suddenly springs back a lot unintentionally!*
- *For safety reasons, high-strength body panels must not be heated when reforming as with normal body panels!*
- *Welding high-strength steel according to the repair manual with the specified separation cuts and welding procedures is permitted.*

What are ultra-high-strength hot-formed steel panels?

They are steel panels that, as their name suggests, are formed in a warm condition at temperatures between 900 °C and 950 °C (1652 °F and 1742 °F). The steel panels gain their high strength through a specific cooling process in the reshaping tool. They are form hardened. The vehicle weight can be reduced without losing strength by using ultra-high-strength hot-formed steel panels. On vehicles with ultra-high-strength hot-formed steel, spot welding devices with inverter technology (see workshop equipment and special tools catalog) are to be used.

Yield points of steel panels used:

Description	Yield points
Normal steel panel	< 160 MPa (N/mm²)
High-strength steel panel	< 220 MPa (N/mm²)
Extra-high-strength steel panel	< 420 MPa (N/mm²)
Ultra-high-strength steel panel	< 1000 MPa (N/mm²)
Ultra-high-strength hot-formed steel panel	>1000 MPa (N/mm²)

5.5.3 Important Notes for Aluminum

Aluminum is largely used in modern vehicle bodies to reduce weight and to increase body stiffness.

In vehicle construction, a distinction is made between:

- Aluminum sheet metal
- Aluminum extrusion profiles (may not be reformed)
- Aluminum cast parts (may not be reformed)

The properties of these components are fundamentally different. If there is damage, pay attention to the vehicle-specific repair manuals.

Note

- *The following instructions only apply to conventional steel vehicles on which aluminum metal parts are installed.*
- *You can see the areas where these panels are used in an image in the respective body repair manual. Refer to ⇒ Rep. Gr. 00 .*

WARNING

Use tools for either steel or aluminum.

Recommendation: special aluminum tool kit in tool cart

5.5.4 Contact Corrosion

Contact corrosion may occur if unsuitable connecting elements (bolts, nuts, washers and etc.) are used. For this reason, only fasteners with a special surface coating are installed. In addition, rubber and plastic parts and adhesive are made of non-conductive materials. If there is any doubt as to whether parts should be reused, always install new parts.

Note

- *Only use original replacement parts. They have been checked and are compatible with aluminum.*
- *Accessories must be approved by Volkswagen AG.*
- *If unapproved materials are used, contact corrosion damage is not covered under warranty.*

5.5.5 Important Notes for Carbon Fiber-Reinforced Polymer (CFRP)

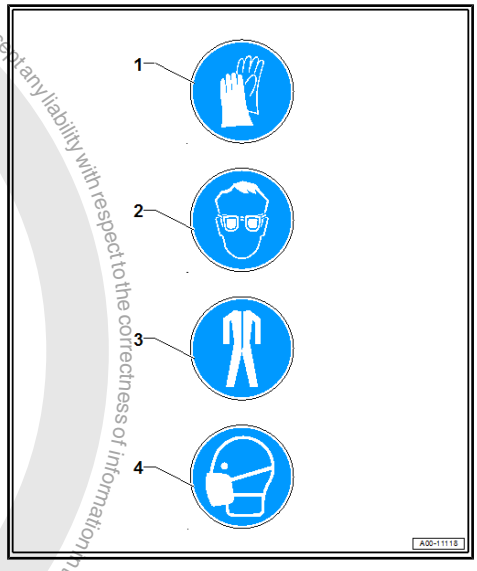
Note

Work on the carbon fiber reinforced polymer (CFRP) areas should only be done by qualified personal.

Occupational Safety

When working on CFRP components make sure there is enough protective equipment.

Evacuation must be used. Acceleration of work by raising the parameters can pose a health risk, when vapors, smoke or dust result.



Personal protective equipment must be used.

1 - Safety Gloves

2 - Protective Eyewear

3 - Protective Apron

4 - Mask

Note

- *Only specially qualified individuals may perform procedures that handle carbon fiber-reinforced polymer (CFRP).*
- *Drilling, sawing, grinding, cutting or any other machining procedures are not permitted on carbon fiber-reinforced polymer (CFRP) components.*
- *Carbon fiber-reinforced polymer (CFRP) is electrically conductive. However it is not permitted to establish a ground connection through carbon fiber-reinforced polymer (CFRP).*
- *When working on current-carrying wires, every contact with carbon fiber-reinforced polymer (CFRP) components must be disabled (risk of short circuit).*
- *When repairing the vehicle and during removal and installation of assemblies for example, every hard contact with carbon fiber-reinforced polymer (CFRP) components must be avoided (risk of invisible damage to the carbon fiber-reinforced polymer (CFRP) structure).*
- *When working on the body, only materials approved by the manufacturer may be used, such as primer, adhesive and rivets.*
- *When working on the body, only procedures approved by the manufacturer may be implemented.*

Carbon fiber-reinforced polymer (CFRP) properties:

CFRP is an abbreviation for carbon fiber-reinforced polymer.

Fiber diameter = approximately 6µm

Specific weight = 1.8g/cm³

Tensile strength = 3530 — 4560 Mpa

Elongation = 1.1 — 1.5 %

Between 1,000 and 24,000 individual fibers are combined into bundles for weaving.

Advantages of carbon fiber-reinforced polymer (CFRP) components

- Extremely light: approximately 60% weight saving as compared to steel, approximately 30% as compared to aluminum.
- Best stability: approximately four times more durable than aluminum.
- 100 % corrosion-resistant.
- Gas- and pressure-tight.
- High long-term heat resistance.
- Hardly measurable thermal expansion

Disadvantages of carbon fiber-reinforced polymer (CFRP) components

- Very expensive material.
- Difficulty evaluating material if damaged. Damage, such as cracks that are not visible to the human eye, require the use of thermal imaging, infrared and X-ray procedures.
- Repairing structure-relevant carbon fiber-reinforced polymer (CFRP) components is generally not permitted; components must be replaced.

Special notes on using carbon fiber reinforced polymer (CFRP) in production vehicles:

When used in vehicles, the properties must be carefully considered with regard to widespread maintenance servicing by workshops. CFRP components forgive damage less than metal. If a component is damaged it must be replaced. To prevent damage to the remaining components in the vehicle, do not use force or large amounts of strength. Use the specified tools. Pay close attention to the procedure and parameters, as they ensure damage-free work. Patience and care for this work is of the utmost importance.

Not all carbon fiber-reinforced polymer (CFRP) is the same.

Unlike metals, the properties of CFRP material cannot be regarded as the same. The properties are component-specific. Depending on the resin, fibers, fiber direction, production process and many other factors, unique component properties are the result.

Deformation behavior

CFRP components can be constructed so that they displace energy. As a result, they burst or they secure the safety cell during a collision. They can be deigned to be deformable from the construction. It is very important to pay attention to and follow the instructions for each component.

Elasticity after application of force

A CFRP component can be deformed through the load, show breaks or inner damage. After removal of the load a spring back is possible. If this is the case an evaluation of the component is very critical, when this has to do with inner components.

Detecting damage

Cracks, scratches and fiber breakage can be assessed from the outside. When the rear side is visible, impact damage can be partly determined. A delamination (layer separation) that may have occurred through an impact reduces the component strength, the bending strength and thus the breaking and component rigidity of the laminate. Because it is not possible to evaluate the damage of CFRP components based solely on a visual inspection and the properties of the components can be drastically worsened by slight damage, it is extremely important to conduct a careful inspection before a damage diagnosis is made.

Overview of nondestructive inspection methods

- Radiography = computed tomography (CT)
- Acoustic = ultrasound, knock test
- Visual = shearography
- Thermal = thermography
- Electrical / magnetic = eddy current testing

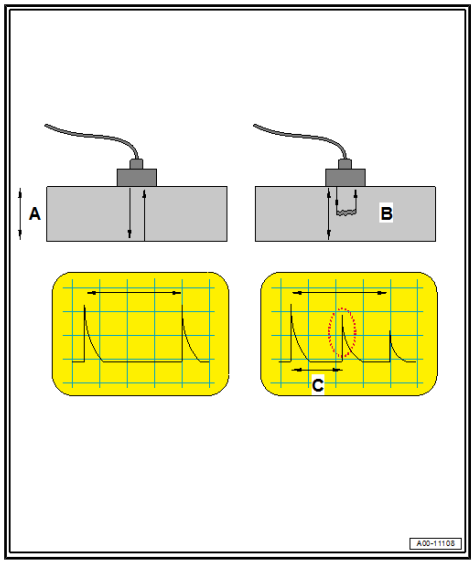
Audi AG uses the ultrasonic method for diagnosing carbon fiber-reinforced polymer (CFRP) components.

Test sends ultrasonic sound pulses with a very short duration (1-10 µs) that pass through the test component. The sound pulses are reflected by the rear wall and return to the test probe as an echo. Compare the data with the data of a malfunction free part

A - Material thickness

B - Error in component

C - Error depth



5.5.6 General Plastic Charcteristics

The areas where plastics are used are very diverse. Property and repair information can be found in the vehicle-specific repair manual, or in the plastic repair chapter:
⇒ “12 Plastic Repair”, page 55 .

5.6 Passive Safety Systems

5.6.1 Restraint Systems (Seat Belt Systems)

WARNING

The seat belt system must be inspected systematically after every accident. If damage is determined at any inspection point, the customer must be informed that it is necessary to replace the seat belt.

Check points:

- Check the seat belt webbing. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Seat Belt Webbing, Checking .
- Check the belt retractor (locking function). Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Automatic Belt Retractor (Locking Function), Checking .
- Visually inspect the seat belt latch. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Seat Belt Latch, Visually Inspecting .

– Check the function of the seat belt latch. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Seat Belt Latch, Checking Function .

– Check the seat belt relays and the belt tongue. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Seat Belt Relays and Belt Tongue, Checking .

– Check the fasteners and mounting points. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Fasteners and Mounting Points, Checking after Collision .

Note

If customer refuses to have a damaged seat belt replaced, appropriate note should be made.

5.6.2 Belt Tensioners, Safety Precautions

- Testing, assembly, and repair work may only be performed by qualified personnel.
- The pyrotechnic propellant has no expiration date, this means it has an unlimited service life and is maintenance-free.
- Belt tensioner components may not be opened or repaired; always use new parts.
- Belt tensioner units which have fallen to the ground must no longer be installed in the vehicle.
- Belt tensioner units that are mechanically damaged (dents, cracks) must always be replaced.
- Belt tensioner units should be installed immediately after removing them from the shipping package.
- The belt tensioner unit is to be returned to shipping package when work is interrupted.
- It is not permitted to leave the belt tensioner unit unattended.
- NEVER treat a belt tensioner unit with grease, cleaning products or anything similar. Do NOT expose the belt tensioner unit to temperatures above 100° C even for a few seconds.

5.6.3 Working on Vehicles With Belt Tensioners

WARNING

Before beginning separation work, straightening work and/or dent removal, remove mechanically activating belt tensioners without load detection (release lock). With electrically activating belt tensioners, the battery ground cable must be disconnected.

Note

If the belt webbing is completely unrolled, the load detection (release lock) hinders the release of the mechanically activated belt tensioner in an accident.

WARNING

With belt tensioners with load detection, the belt webbing must not be pulled out when performing separation work, straightening work and/or dent removal. If strong vibrations are generated by separating work, straightening work or dent removal, the belt tensioners with load detection must be removed.

Information can be found in the vehicle-specific repair manuals. Refer to ⇒ Body Interior; Rep. Gr. 69 ; Passenger Protection; Seat Belts .

5.6.4 Disposal of Undeployed Pyrotechnic Components

- Airbags,
- Seat belts,
- Pyrotechnic battery cut-out elements,
- Active front lid release unit

These must be returned in their original packaging for proper recycling/disposal in accordance with national regulations. If there are any questions, contact the distributor or importer.

Note

Pyrotechnic components deployed in an actual accident can be disposed of as industrial waste.

WARNING

This does not apply to seat belt tensioner that function according to the "Wankel tensioner principle".

These should be handled like undeployed pyrotechnic components, because they cannot be checked using service equipment if all pyrotechnic materials have deployed.

5.6.5 Restraint Systems (Airbag Systems)

Refer to the vehicle-specific repair manuals for all procedures on the airbag systems. Refer to ⇒ Body Interior; Rep. Gr. 69 ; Airbag System; Component Location Overview - Airbag System as well as the corresponding safety precautions in ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Safety Precautions when Working on Pyrotechnic Components .

WARNING

- *The battery ground cable must be disconnected when working on the airbag system or when performing alignment work during body repairs.*
- *Switch off ignition before connecting battery!*
- *There should not be any people inside the vehicle when connecting the battery!*
- *Airbag components must not be exposed to temperatures over 100 °C (212 °F), even if for a short period of time.*
- *Airbag components must not come in contact with grease, cleaning materials, oil, or similar substances.*
- *Mechanically damaged airbag components must be replaced.*
- *Wash hands after touching deployed airbag units.*

5.6.6 Important Notes when Working on Seats with Side Airbag

WARNING

The safety precautions must always be followed when removing the seats.

Follow the safety precautions from the vehicle-specific repair manual. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Additional Safety Precautions for Side Airbags .

5.6.7 Instructions for Disposal

Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety precautions; Storage, Transport, and Disposal of Airbag, Seat Belt Tensioner, and Battery Cut-Out Units (Pyrotechnic Components) .

6 Thermal Joining Techniques

The thermal joining techniques currently used in body repair procedures are presented in the following chapter.

6.1 Resistance Spot Welding

The basic principle for repair welding is to re-create as much of the original welded connection as possible.

This requires that:

- The panels to be welded overlap.
- Both sides of the weld point are accessible to the electrodes.
- The resistance spot welder is strong enough to produce weld spot diameters like at the factory.

During body repair work, access to weld points varies. Therefore, each resistance spot welder must have a complete set of the most common types of electrodes.

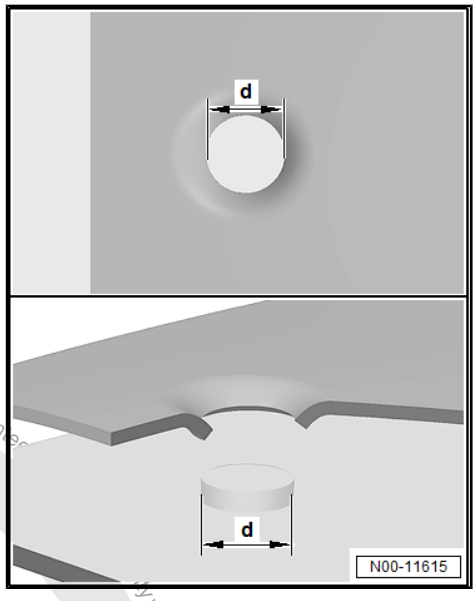
Zinc-Coated Panels, Straight-Line Welding

When performing resistance spot welding on zinc-coated panels, observe following points:

- The flanges to be spot welded must lie against each other. Clamp flanges with pliers, if necessary.
- This is especially important with high-strength panels because the electrode strength is not great enough.
- Do not weld directly by the clamping pliers with the welding tongs because a large amount of the welding current flows through here due to shunting.
- With small spot weld spacing, weld points in a sequential order or weld every third point to secure, then finish welding. This minimizes the shunting influence.
- Observe Owner's Manual and adjustment notes from manufacturer.

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.



Test Button Weld

– For the necessary button weld diameter, determine the panel pairing based on the manufacturer's specifications and check with test panels.

– Check all spot weld connections 100% with a chisel test.

Qualitatively acceptable spot welds do not tear into the contact surface, but rather “unbutton”.

– Calculate the button weld diameter with the following formula and check on test panels before beginning repair.

  Square root of T1*3,5*1,15

Note

T1 is the thinnest panel in a panel combination, for example, panel combination of 1.5 mm and 0.8 mm. Example calculation: root of 0.8 x 3.5 x 1.15 = 3.6 mm button weld diameter. With the test, the small welded test strip is rolled or pulled from the second test strip with force perpendicular to the panel surface.

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

WARNING

- *Welding and sanding must always be carried out with ventilation.*
- *Never weld and sand in any area at the same time.*
- *Clean the work area regularly depending on the amount of dust.*
- *Accumulated dust must not be blown away with compressed air.*
- *The ventilation system must be cleaned regularly.*
- *Also, observe the corresponding regulations from the UVW and the BG.*

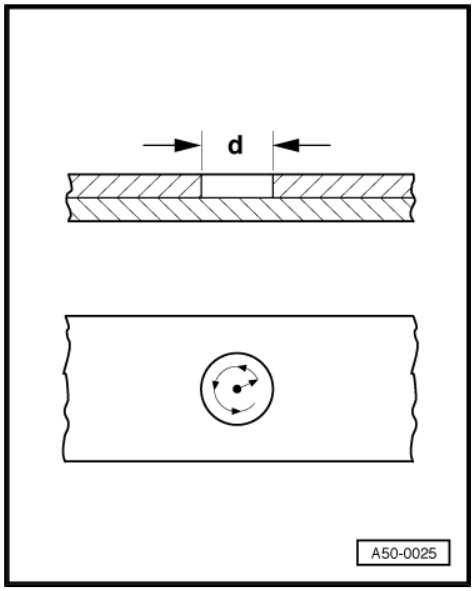
6.2 Gas-Shielded Plug Welding

Gas-shielded plug welding is mostly used when the standard implemented resistance spots cannot be recreated, for example due to limited accessibility.

Always refer to the vehicle-specific repair manuals for this.

General Information regarding Gas-Shielded Plug Welding

- Loosen weld points with spot weld cutter or sand off.
- Remove the damaged part, separate with a chisel if necessary.
- Sand down projections.
- Adapt the new part.
- Drill the top panel for plug welding (refer to the vehicle-specific repair manual for the drill bit diameter).
- Clean the flanges and remove the oxide coating.
- Perform plug welding from center outward.



Note

Riveting are also permitted, to some extent. Observe the body repair repair manual.

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

WARNING

- *Welding and sanding must always be carried out with ventilation.*
- *Never weld and sand in any area at the same time.*
- *Clean the work area regularly depending on the amount of dust.*
- *Accumulated dust must not be blown away with compressed air.*
- *The ventilation system must be cleaned regularly.*
- *Also, observe the corresponding regulations from the UVW and the BG.*

6.3 Gas-Shielded Arc Continuous and Stitch Weld Seams

Gas-shielded arc continuous and stitch weld seams are primarily used when joining butt-welded or overlapping separating points. Due to the very high welding temperatures and the altered material properties associated with it, there is increasingly limited use of this joining process. Always refer to the vehicle-specific repair manuals for this.

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

WARNING

- *Welding and sanding must always be carried out with ventilation.*
- *Never weld and sand in any area at the same time.*
- *Clean the work area regularly depending on the amount of dust.*
- *Accumulated dust must not be blown away with compressed air.*
- *The ventilation system must be cleaned regularly.*
- *Also, observe the corresponding regulations from the UVW and the BG.*

6.4 MIG Soldering

MIG soldering primarily differs from the gas-shielded arc stitch or continuous weld seam in that it requires significantly lower temperatures. The advantage of MIG soldering is a significant reduction in material distortion in the components being connected. The joining process is also suitable for larger flat components.

Other advantages include:

- Minimal structural changes in the components.
- Minimal damage to the corrosion protection applied during production.
- Preserves the zinc coating on the components.

What is MIG soldering?

- Brazing procedures are also called gas-shielded metal soldering.
- The base material (body panel) is not melted on; the solder coats the flanks and connects the components.
- MIG stands for metal inert gas. The inert gases are not actively involved in the processes between the electric arc and welding filler material.
- Argon or helium are among the inert gases to be used, and are mixed with carbon dioxide or oxygen.
- Up to 450 °C (842 °F): soft-solder
- Above 450 °C (842 °F): braze

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

WARNING

- *Welding and sanding must always be carried out with ventilation.*
- *Never weld and sand in any area at the same time.*
- *Clean the work area regularly depending on the amount of dust.*
- *Accumulated dust must not be blown away with compressed air.*
- *The ventilation system must be cleaned regularly.*
- *Also, observe the corresponding regulations from the UVW and the BG.*

6.5 Aluminum Welding

Metal Inert Gas (MIG) welding is used by the manufacturer and in service.

Argon is used as inert gas.

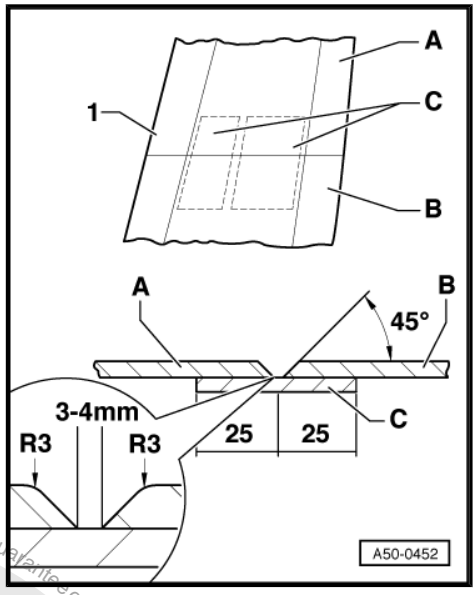
– Before welding, remove any underbody protection and paint from the components.

– Then remove the approximately 40 mm of the oxide layer on both sides using a stainless steel brush.

– To avoid formation of cracks, weld seams must be drawn around section corners.

Note

- *Use the Panel - 4D0 898 103- for welding practice and repairs.*
- *Additional information can be found in the "aluminum welding" training guide.*



Same Material, Underlying

Same material -C- is created from remainder of new -B- or old parts -A-. Same material should also be underlaid on beaded panel edges. On small cross sections or large panel edges, the same material is separated.

– Bevel both panels 45°. Round outer edge (radius = 3) and chamfer inner edge.

Panel tips must be 3 to 4 mm apart.

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

WARNING

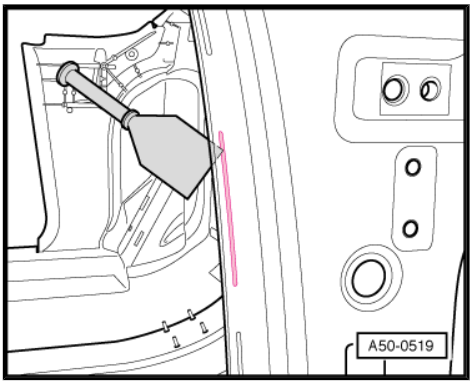
- ***Welding and sanding must always be carried out with ventilation.***
- ***Never weld and sand in any area at the same time.***
- ***Clean the work area regularly depending on the amount of dust.***
- ***Accumulated dust must not be blown away with compressed air.***
- ***The ventilation system must be cleaned regularly.***
- ***Also, observe the corresponding regulations from the UVW and the BG.***

6.6 Laser Welding

Note

This joining procedure is only used during manufacture.

Information on the replacement procedures can be found in the following chapter overviews. Refer to or ⇒ "6.9 Replacement Joining Procedures in Repair (Aluminum)", page 30 .



Always refer to the vehicle-specific repair manuals for this.

In laser welding, a high-energy light beam is directed onto the weld point via optical lenses or fiber optics. During the welding process, the upper panel is melted through and as well as with the lower panel on the surface, thereby forming a weld without using any additional materials.

6.7 Laser Soldering

Note

This joining procedure is only used during manufacture.

Information on the replacement procedures can be found in the following chapter overviews. Refer to or ⇒ “6.9 Replacement Joining Procedures in Repair (Aluminum)”, page 30 .

Always refer to the vehicle-specific repair manuals for this.

Generally, an additional material is used during laser soldering. The soldered connection is not fundamentally different than that of an MIG soldered connection.

Only the fusing of additional material does not occur using electric arc, but rather using a concentrated light beam the same as for laser welding. Due to the laser technology, the energy can be applied at a precise point. Undesirable side effects, such as heat distortion, are negligible.

6.8 Replacement Joining Procedures in Repair (Steel)

In production	In repair
Spot welds	Spot weld bonding / MAG plug welding / MAG welding
MAG Welding	MAG Welding
MIG Soldering	MAG Welding
Laser welding	MAG Welding
Laser Soldering	MIG soldering Bonding MAG welding Pay attention to information in repair manual
Bonding	Bonding / MAG welding
Spot weld bonding	Bonding with spot welding / additional spot welds / additional MAG welding
Pop rivets	Pop rivets Only use pop rivets specified in the repair manual. Commercially available pop rivets generally do not have sufficient strength.

6.9 Replacement Joining Procedures in Repair (Aluminum)

In production	In repair
MIG welding	MIG welding
Spot welds	Not used
MIG Soldering	Not used
Laser welding	Bonding and riveting
Bonding	Bonding and riveting
Punch Rivets	Punch Rivets

In production	In repair
Pop rivets	Pop rivets Only use pop rivets specified in the repair manual. Commercially available pop rivets generally do not have sufficient strength.

7 Cold Joining Procedures

7.1 Bonding

To increase body stiffness and strength, adhesive and spot-weld bonded joints are being increasingly used in production.

They are differentiated as follows:

- In purely bonded joints, the sheet metal parts are only bonded by adhesive.
- For adhesions with additional spot or rivet connections, one may refer to them as hybrid bonding.

Note

The bonded joints may only be restored with the materials specified in the repair manual or replacement parts catalog.

7.1.1 Aluminum Bonded Joints, Creating

Note

The following descriptions do not replace the vehicle-specific repair manual.

Old flange pretreatment

– Remove adhesive residue, paint, wax, etc.

– Sand the adhesive surface down to bare metal with clean 80 or 100 grit sanding disc.

– Treat flange with silicate stone.

A silica-based adhesive layer is produced that ensures a long-lasting bonded joint. The surface becomes matte.

– Remove grinding dust with a clean brush (do not use any solvents).

– Apply a thin coat of aluminum primer with a brush and let it dry.

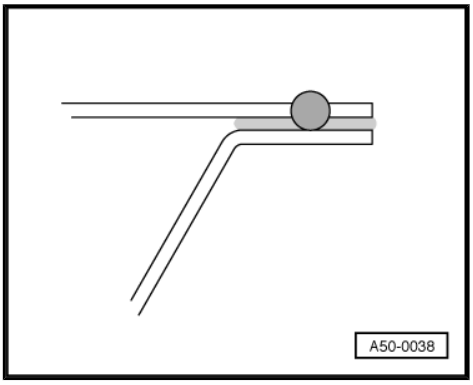
Flange pretreatment on new part:

– Clean the painted flange with special cleaner.

WARNING

When painting the inside of the new parts, cover the adhesive surfaces.

– Apply adhesive to the body side, fit the components and secure. Adhesive bead: 3.5 mm.



Fit and secure the components within the processing time specified by the adhesive manufacturer; otherwise, the adhesion strength on the flanges will be insufficient due to a buildup of film on the surface.

– Tighten the rivets and wipe off any escaping adhesive.

The rivets must be tightened before setting the adhesive. The available times are therefore dependent on the ambient temperature.

Always note the specifications on the technical data sheet for the adhesive.

Note

If the adhesive escapes on both sides along the entire length, too much was applied.

The adhesive must harden before any other surface treatment.

Note

- *On large parts, such as the roof, it is necessary to perform the work with a helper. Otherwise the adhesive will dry before work is complete.*
- *Before positioning the mixing nozzle, make sure the double cartridge openings are clean. Firmly install the mixing nozzle and press out a bead about 10 cm long and apply adhesive.*
- *After breaks up to 30 minutes, press out a bead about 10 cm long so that new material is mixed. After breaks over 30 minutes, replace mixing nozzle and press out a 10 cm long bead. If more cartridges are needed for a repair, these can be treated with a mixing nozzle.*

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

Note

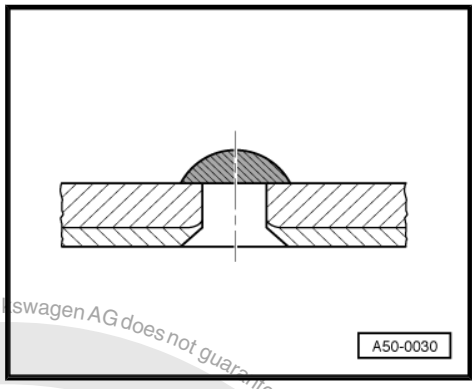
- *Wear safety gloves and protective eyewear.*
- *Avoid direct contact of the adhesive with the skin.*
- *Avoid inhaling solvent vapors.*
- *Only process adhesive in well-ventilated areas.*
- *Always note the hazard information from the manufacturer.*
- *Also note the accident prevention regulations applicable in the country.*
- *Note the corresponding safety data sheets for the adhesive.*

7.2 Rivets

Note

Please refer to the vehicle-specific repair manuals or the Workshop Equipment Catalog for information on required special tools, testing equipment, and tools.

7.2.1 Solid Rivet

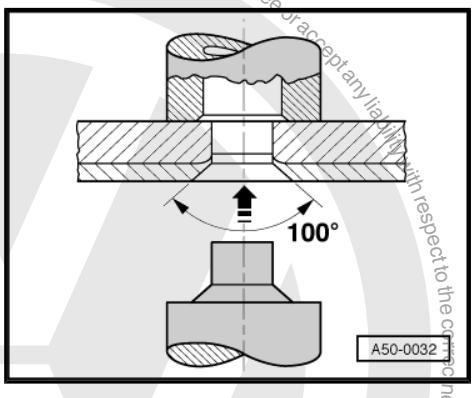


Opening the solid rivet

– First make separating cuts, if necessary.

– Sand off closing head and press out the solid rivet with the rivet tool.

– Remove the damaged part, separate with a chisel if necessary.



Solid Rivet, Installing

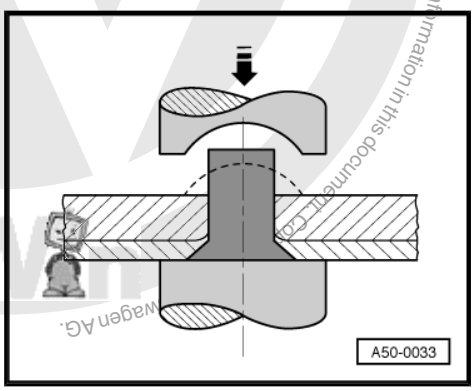
– Fit new parts, apply adhesive and place new part on body and secure.

– Stamp the flange with the rivet tool.

When stamping, the punch hole and the imprint are made in one process.

Note

Adjust the rivet tool to material thickness for all procedures. To prevent flange from gaping after stamping, insert staples in the punched holes.



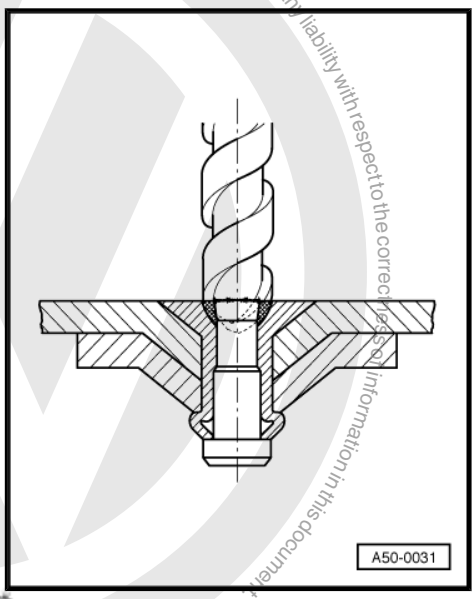
– Insert the solid rivet and affix the closing head using the rivet tool.

There are corresponding rivet tool inserts for the various rivet diameters.

Note

- *Contrary to the series, all rivet connections are also bonded in service. Refer to for the adhesive connection. The solid rivet is made out of aluminum.*
- *There are different solid rivets available. Refer to the vehicle-specific instructions for this.*

7.2.2 Pop Rivet



Opening the pop rivet

– First make separating cuts, if necessary.

– Drill out the pop rivet, drill bit diameter 4.5 mm.

– Remove the damaged part, separate with a chisel if necessary.

WARNING

Catch pop rivet remnants. If remnants fall into the cavities and can no longer be removed, they must be worked into the filler wax.

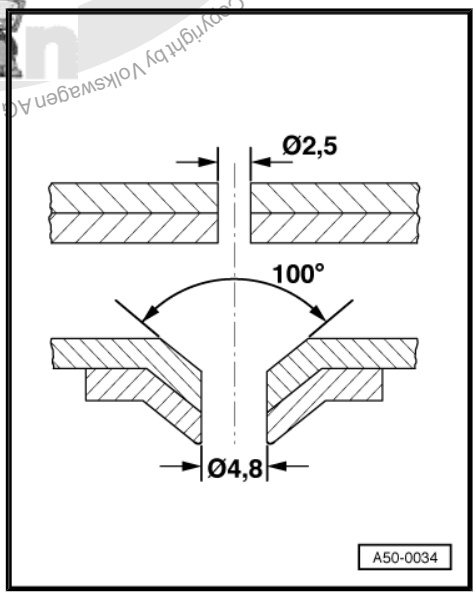
Pop Rivet, Installing

– Fit new parts, place on body and secure.

– Drill old and new part or same material together, 2.5 mm diameter.

– Remove the new parts.

– Imprint drilled holes in all parts with rivet tool.

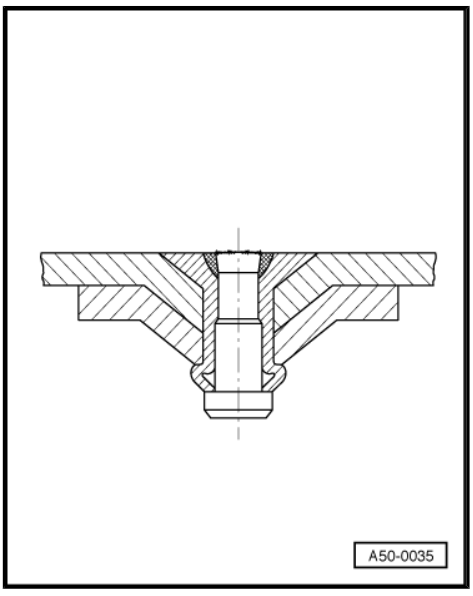


Note

- *Adjust the rivet tool to material thickness for all procedures. The diameter increases to 4.8 mm with imprinting. The imprint must face inward on all parts.*
- *Assembly sections cannot be imprinted. Lower the new part with assembly section, remove part and drill out the assembly section to 4.8 mm diameter.*

– Apply the adhesive.

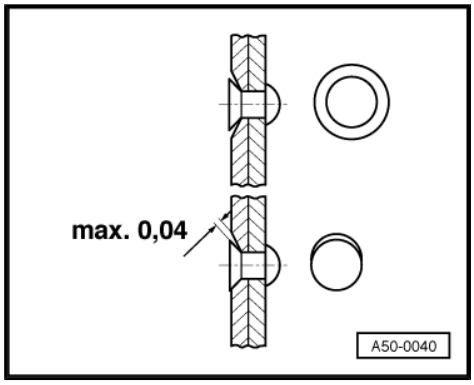
– Insert the pop rivet and pull the pin with rivet pliers.



Note

- *Contrary to the series, all rivet connections are also bonded in service. Refer to for the adhesive connection.*
- *There are different pop rivets available. Refer to the vehicle-specific instructions for this.*

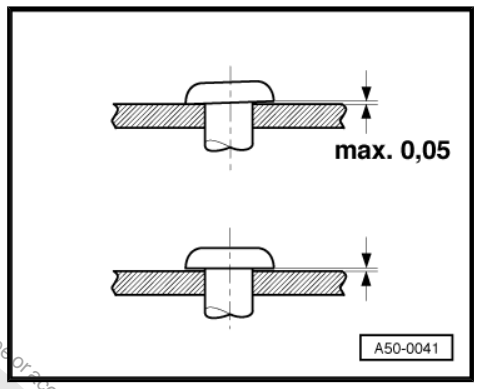
7.2.3 Rivet Problems



Open countersinks

Open countersinks over the entire circumference are not permitted. Partially open countersinks up to a gap width of 0.04 mm are permitted.

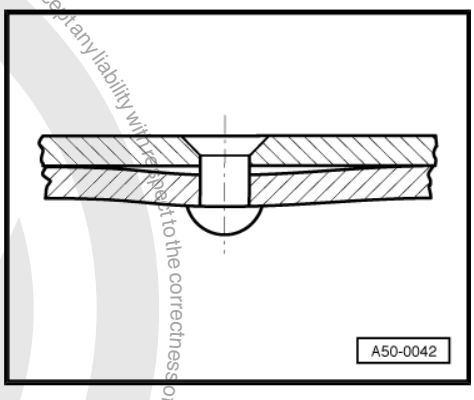
Sizing, for example, with a cambered die, is permitted as long as the tolerance for closing and setting head are maintained.



Non-fitting rivet heads

Loose rivets are never permitted.

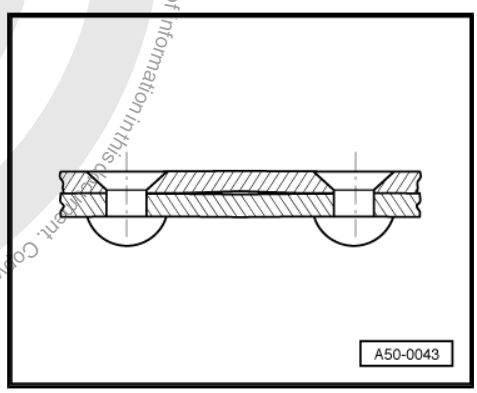
A partial gap up to 0.05 mm is permitted.



Bulges at the rivet connection

During the riveting process, the rivet material is pushed into the gap and causes bending stress to the rivet.

This type of bulge is not permitted.

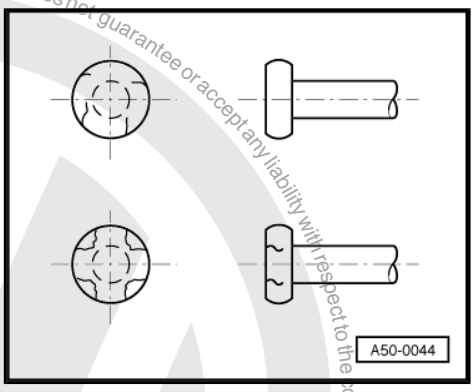


Bulges between the rivet connections

Bulges may not exceed a gap width of 0.3 mm.

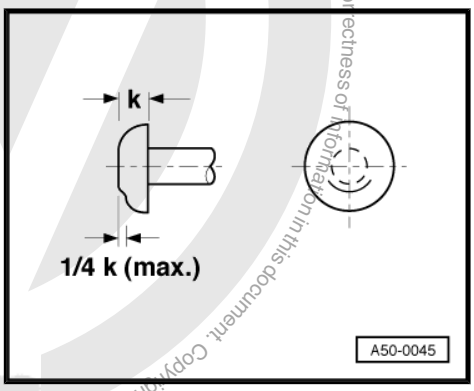
Shear cracks

Cracks that do not overlap are permitted (top).



Notches

The permitted notch depth is 1/4 * height of the head.

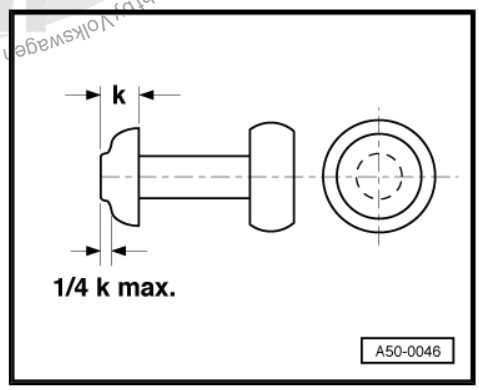


Rings

Rings form in the head when a riveting header is used that is too small.

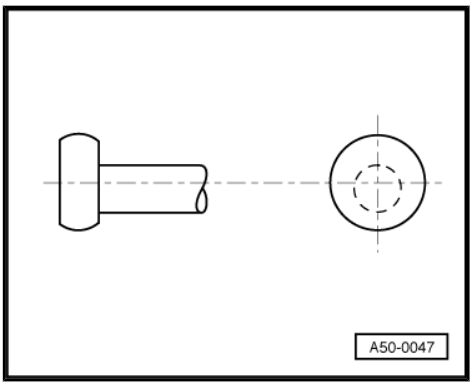
The permitted depth of the rings is 1/4 * height of the head.

The fully formed ring is not permitted.



Offset closing head

An offset head is not permitted if the head touches the shaft and the rivet hole is visible.



7.2.4 Kerb-Konus Rivets

Kerb-Konus rivets coated with stainless steel are inserted.

Note

Due to the corrosion risk, stainless steel rivets may not be drilled out or sanded.

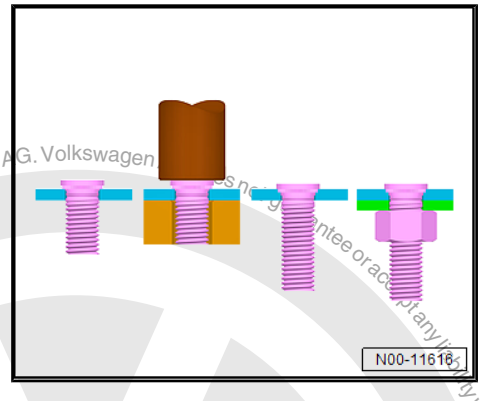
Riveting processes

A - Setting the rivet

B - Pressing process

C - Inserting and punching out

D - Finished Kerb-Konus rivet connection



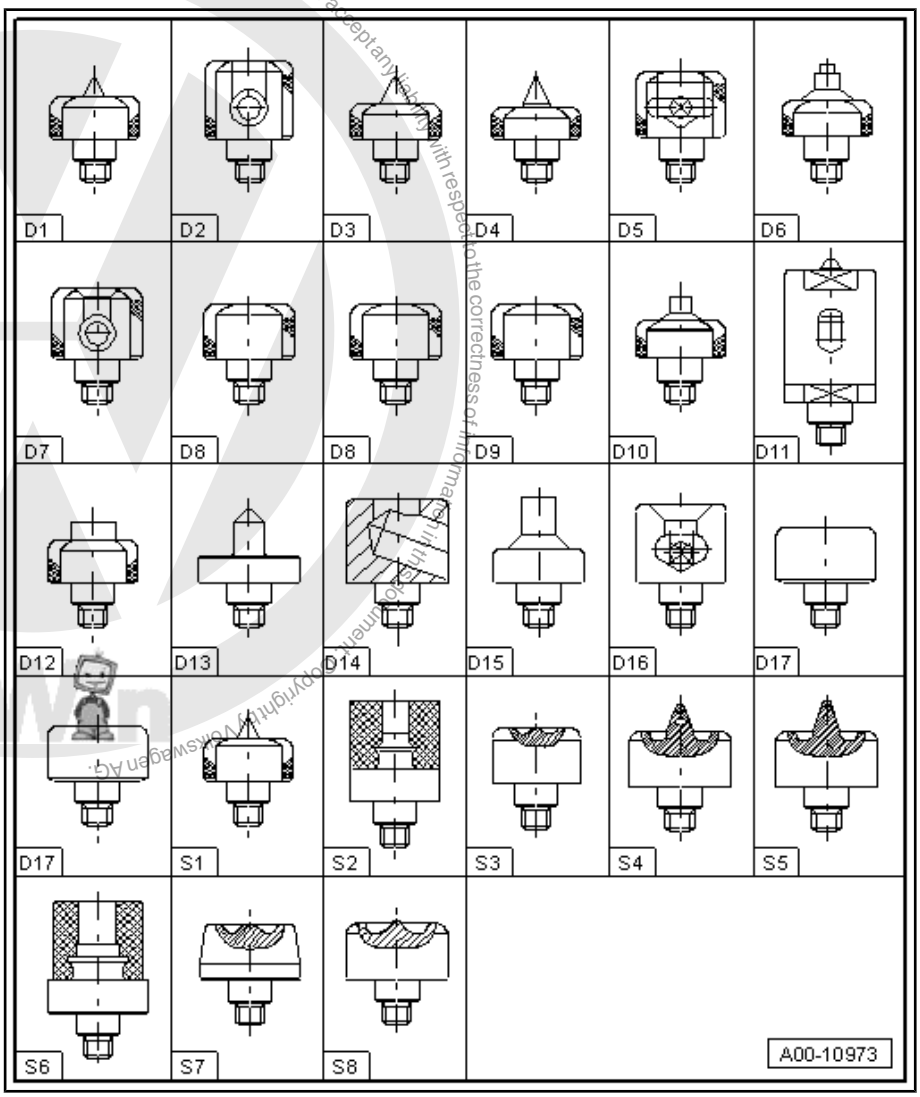
Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

7.3 Overview of Rivet Heads

Note

- *This card serves only as a guide. Use the accompanying Owner's Manual for the description of the procedure as well as the areas of application.*
- *To increase the service life of the rivet head maker, use commercially available cutting fluid.*



D 1 + D 2 - 3.2 mm Diameter Press - Punch Rivet

D 2 + D 3 - 3.2 mm Diameter Press - Punch Rivet

D 2 + D 5 - 5 mm Diameter Press - Punch Rivet

D 3 + D 5 - 5 mm Diameter Press - Punch Rivet

D 4 + D 5 - 5 mm Diameter Press - Punch Rivet

D 5 + D 12 - 8 mm Diameter Hole Punch - Welded Joint Drill

D 6 + D 7 - 4.8 mm Diameter Hole Stamp - Pop Rivet

D 8 + D 8 - Panel Reshaping

D 8 + D 9 - Pressure of 4 mm - Solid Rivet

D 10 + D 11 - Hole Punch and Stamp 4 mm Diameter - Solid Rivet

D 13 + D 14 - 5.3 x 7.5 mm Diameter Press - Punch Rivet

D 17 + D 17 - Panel Reshaping

D 15 + D 16 - 6.0 mm Diameter Hole Stamp - Solid Rivet

D 17 + D 17 - Pressure of 6.0 mm - Solid Rivet

S 1 + D 2 - 3.2 mm Diameter Press - Punch Rivet

S 2 + S 3 - 3.2 mm Diameter Positioner - Punch Rivet

S 4 + D 5 - 5.3 x 5.5 mm Diameter Press - Punch Rivet

S 5 + D 5 - 5.3 x 6.5 mm Diameter Press - Punch Rivet

S 6 + S 7 - 5.3 x 5.5 mm Diameter Positioner - Punch Rivet

S 6 + S 8 - 5.3 x 6.5 mm Diameter Positioner - Punch Rivet

7.4 Rivets and Tools Overview

Refer to ⇒ Rep. Gr. 00 ; Safety Precautions

Special tools and workshop equipment required

- Pop Rivet Pliers - VAG1753B-
- Pop Rivet Pliers - VAG1765C-
- Pop Rivet Nut Pliers - VAS5072A-
- Pneumatic Pop Riveter - VAG2003A-
- Pneumatic Rivet Gun - VAS6759-
- Rechargeable Riveter - VAS5279A-
- Rechargeable Riveter - VAS843 001-
- Pneumatic-Hydraulic Riveter Set - VAS6790-

- Compact Riveting Device - VAS6792-
- FD Bolt Socket - VAS852007A-
- Miracle Alurepair Plus-System - VAS852 001-

Rivet	Part number size	VAG1765	VAS5279	VAS5072	VAG17753 B	VAG20003 A	VAS6790	VAS67792	VAS843001	VAS67559	VAS8520007	VAS8520001
Punch Rivet	4D0 803 217 N 3.35 x 5 mm		x				x		x			
Punch Rivet	4D0 803 217 Q 3.35 x 4 mm		x				x		x			
Punch Rivet	4D0 803 217 L 5.3 x 5 mm		x				x		x			
Punch Rivet	4D0 803 217 M 5.3 x 6.5 mm		x				x		x			
Punch Rivet	N 909 261 02 5.3 x 6 mm		x				x		x			
Punch Rivet	N 911 365 01 5.3 x 7.5 mm		x				x		x			
Punch Rivet	N 911 348 01 5 x 4.2 mm		x				x		x			
Alumi-num solid rivet	N 103 239 01 4 x 8 mm		x				x		x			
Alumi-num solid rivet	N 103 240 01 4 x 12 mm		x				x		x			
Alumi-num solid rivet	N 107 440 01 6 x 10 mm		x				x		x			
Alumi-num solid rivet	N 107 441 01 6 x 12 mm		x									

Rivet	Part number size	VAG1765	VAS5279	VAS5072	VAG1753 B	VAG2003 A	VAS67900	VAS67792	VAS843001	VAS67559	VAS8520207	VAS8520201
Alumi-num pop rivet with a coun-ter-sunk head	4E0 809 864 A						x	x	x	x		
Alumi-num pop rivet with a semi-round head	8Z0 809 864						x	x	x	x		
Flow Drill Bolts	WHT. 003.873 M5 x 25										x	
Flow Drill Bolts	WHT. 006.547 M5 x 20										x	
Flow Drill Bolts	WHT. 007.052 M5 x 18										x	
Threa ded rivet	N 907 163 01 14 mm				x	x	x	x	x	x		
Threa ded rivet	N 907 162 01 10 mm				x	x	x	x	x	x		
Threa ded rivet	N 907 161 01 22 mm				x	x	x	x	x	x		
Threa ded rivet	N 907 160 01 6 mm				x	x	x	x	x	x		
Pop Rivet	WHT 005 413 A 6.5 mm rivet material strength : 5-9 mm				x	x	x	x	x	x		
Pop Rivet	WHT 005.697 6.5 mm rivet material strength : 3 - 4.8 mm				x	x	x	x	x	x		

Rivet	Part number size	VAG1765	VAS5279	VAS5072	VAG1753 B	VAG2003 A	VAS6790	VAS67792	VAS843001	VAS67559	VAS8520007	VAS8520001
Pop Rivet	WHT 911.527 .01 6.5 mm rivet material strength : 4.5 - 7.0 mm				x	x	x	x	x	x		
Pop Rivet	N 909 236 01 4.8 mm rivet material strength : 2.4 - 4.8 mm				x	x	x	x	x	x		
Pop Rivet	N. 906.924 .02 4.8 mm rivet material strength : 1.5 - 3.5 mm				x	x	x	x	x	x		
Pop Rivet	4S0 843 658				x	x	x	x	x	x		
Pop rivet screw	WHT 005 180	VAG1765C/2										
Pop rivet screw	N. 910.011 .01	VAG1765C/4										
Pop Rivet Nut	N. 910.377 .01 M10	VAG1765										
Pop Rivet Nut	N. 908.568 .02 M8	VAG1765										
Weld Studs	VAS852001/1 5 mm							x				x
Weld Studs	VAS852001/2 4 mm							x				x

Refer to ⇒ Rep. Gr. 00 ; Safety Precautions

7.5 Flow-Drill Bolts

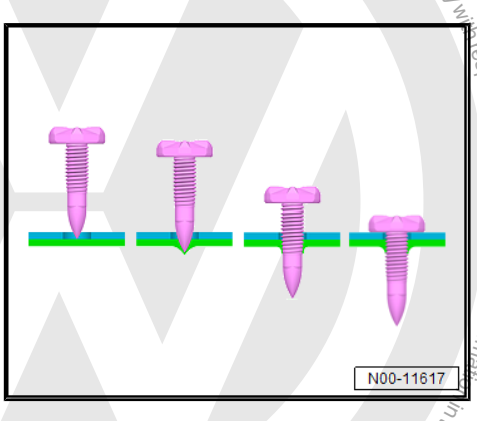
⇒ “7.5.1 Flow Drill Bolt Connection, Producing, Upper Section Pre-Punched”, page 43

⇒ “7.5.2 Flow Drill Bolt Connection, Producing, Upper Section Not Pre-Punched”, page 43

⇒ “7.5.3 Flow Drill Bolt Connection, Creating, When Replacing Upper and Lower Section”, page 44

When using flow-drill bolts, the lower component is heated by the frictional heat generated by the turning bolt. Then the self-tapping screw is screwed into the soft aluminum.

Flow-Drill Bolt Connections, Servicing



Note

- *Flow-drill bolts have been introduced on the Audi R8 that can be replaced using the FD Bolt Socket - VAS852 007A- .*
- *The repair concept for the pure aluminum body components is the same as the repair procedures used on previous Audi aluminum vehicles.*
- *Using the tool, allows the best use of the threaded connection during repairs.*

The production of a flow drill bolt connection is presented in the following based on three examples.

7.5.1 Flow Drill Bolt Connection, Producing, Upper Section Pre-Punched

- Loosen the flow drill bolt threaded connection using a socket for flow drill bolts.
- Remove the upper section.
- Preparing the connection points for applying adhesive.
- Clean the adhesion area with cleaning solution.
- Prepare and clean the adhesion area with a silicate stone.
- Apply aluminum primer using the applicator on the adhesive surfaces.
- Apply two-part epoxy adhesive to the entire area using a pneumatic adhesive gun.
- Position the new part and tighten using the flow drill bolt socket and tighten new bolts to 8 Nm.

7.5.2 Flow Drill Bolt Connection, Producing, Upper Section Not Pre-Punched

- Loosen the flow drill bolt threaded connection using a socket for flow drill bolts.
- Remove the upper section.
- Insert the hole finder into the existing flow drill bolt threads.
- Position the new part.
- Label the holes in the new part by hitting it lightly with a plastic hammer.

Note

Allow for the flow drill bolt repair set offset: only make a superficial mark if possible.

– Remove the upper section.
– Dill 7 mm diameter holes in the new part.
– Preparing the connection points for applying adhesive.
– Clean the adhesion area with cleaning solution.
– Prepare and clean the adhesion area with a silicate stone.
– Apply aluminum primer using the applicator on the adhesive surfaces.
– Apply two-part epoxy adhesive to the entire area using a pneumatic adhesive gun.
– Position the new part and tighten using the flow drill bolt socket and tighten new bolts to 8 Nm.

7.5.3 Flow Drill Bolt Connection, Creating, When Replacing Upper and Lower Section

– Loosen the flow drill bolt threaded connection using a socket for flow drill bolts.
– Remove both sections.
– Using both parts at the same distance as with the original connection, make 4 mm holes.
– Remove the new parts.
– Expand the 4 mm holes in the upper section to 7 mm.
– Preparing the connection points for applying adhesive.
– Clean the adhesion area with cleaning solution.
– Prepare and clean the adhesion area with a silicate stone.
– Apply aluminum primer using the applicator on the adhesive surfaces.
– Apply two-part epoxy adhesive to the entire area using a pneumatic adhesive gun.
– Position the new part and tighten using the flow drill bolt socket and tighten new bolts to 8 Nm.

Flow Drill Bolt Repair Set

The repair set serves as a means of marking the holes on the new parts where the flow drill bolt threaded connections are used. Using the hole finders, it is possible to transfer the hole positions for the flow drill bolts to the Audi aluminum vehicles if a repair is required. First loosen the old flow drill bolts by using the socket. Then the damaged panel is removed. Now the flow drill bolt repair set is installed in the existing holes in the aluminum panel that was not replaced. Do this using the ring wrench. The new aluminum panel is aligned to the vehicle and attached with crimping pliers. Using light hammer strokes (rubber hammer), the holes from the existing panel will be transferred onto the replacement part with assistance from the flow drill bolt repair set. The replacement part that now contains the marks is removed again. Holes are drilled at the transferred marks. It is then possible to

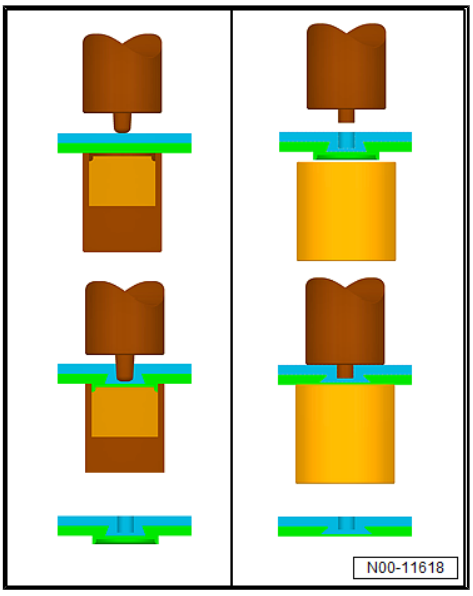
secure the flow drill bolt threaded connections of the new part to the body using the socket

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

7.6 Clinching

Clinching is a press-joining process to connect sheet metal without using additional materials. One can expect to apply it to joining procedures as well as to reforming procedures, because the connection is attained by reforming the material.



Repair Information

- First make separating cuts, if necessary.
- Remove the old flange by peeling.
- Align the remaining flange.

Note

Adjust the rivet tool to material thickness for all procedures.

- Remove the damaged part, separate with a chisel if necessary.
- Fit new parts, and install solid or pop rivets based on the repair manual “Body Repair”.

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

8 Separation Technologies in Body Repair; Application

8.1 Drilling

Drilling is used to loosen resistance weld spots and rivets. Make sure no underlying components are damaged while drilling. When loosening two or more welded connections, the panel remaining on the vehicle may not be impaired more than necessary. After drilling, carefully remove any drill shavings from the cavities (vacuum).

8.2 Sawing

The technician will decide between the two established device types for sawing:

- Short stroke pneumatic saw
- Oscillating saw

Advantages of the short stroke pneumatic saw:

- Faster separation.
- Possible to saw curves.
- Can also be inserted at sharply angled profiles.

Advantages of the oscillating saw:

- Clean, straight cuts.
- Low penetration depth, therefore it is particularly suitable for double-layer panels.

Note

After sawing, carefully remove any saw shavings from the cavities (vacuum).

8.3 Sanding

Sanding can be a very favorable alternative to drilling, especially when loosening high-strength welded connections. Weld points, laser weld connections, or brazed seams can be loosened very efficiently by sanding. Also make sure here that the underlying materials are not impaired or damaged any more than necessary.

Disadvantages of sanding:

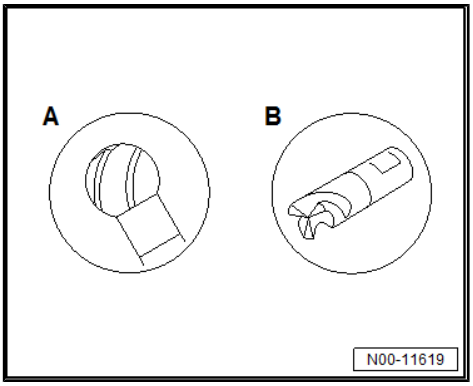
- Due to the flying sparks, extensive protective measures are necessary on the vehicle and in the surrounding area.
- Higher temperature build-up than when drilling, thus more damage to residual material and corrosion protection.

8.4 Milling

In body repairs, the technician decides between a ball end nose mill -A- and a BTR mill -B-.

A ball end nose mill is used if the spacial conditions do not allow the BTR mill to be used for loosening weld points.

When working with the BTR mill, it must be made sure that cuts do not tilt into the high-strength steel. They can break easily due to the hardness of the cuts. Therefore, it should always be worked with a suitable tool (not a hand drill).



8.5 Bonded Joints, Detaching

Body bonded joints are detached by applying heat. The adhesive in the vehicle construction and the repair is destroyed at temperatures 180°F – 200°C (356–392°F).

WARNING

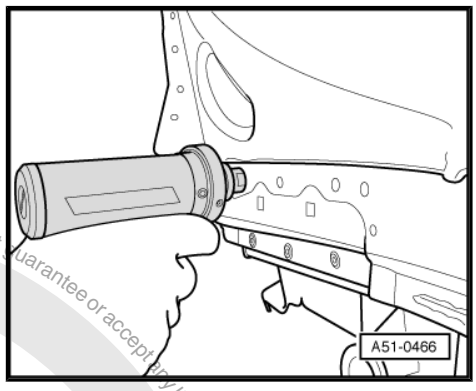
Poisonous gases are emitted when detaching bonded joints; make sure the area is well ventilated and there is suitable fume extraction.

8.6 Removing Rivets Accessible on One Side

Work Sequence

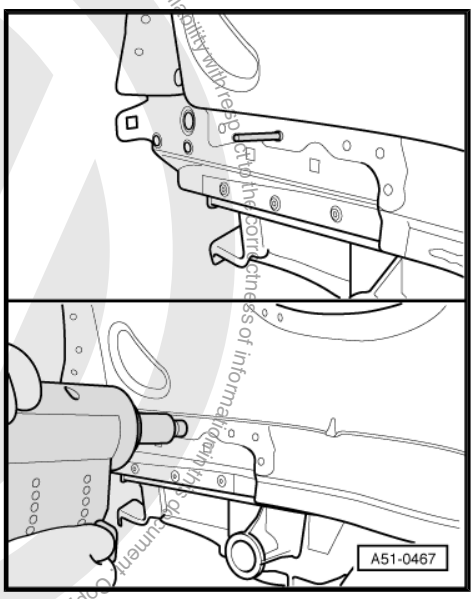
– Remove the paint and oxide coating from the rivet head and the connection point for the ground clamps.

– Bring the ground clamps as close as possible to the rivets.



– Weld the weld studs onto the rivet.

– Remove the rivet using the weld studs and the specified tools.



Note

Refer to the vehicle-specific repair manual for tool and material information.

9 Surface Repairs

Note

Generally, the inner corrosion protection must be paid attention to during all bulge corrections.

9.1 Dent Removal Techniques, Steel Panel

9.1.1 “Classic” Dent Removal Procedure, with Paint Damage

The classic dent removal method using a hammer and counterhold is rarely still used on modern vehicle bodies.

The disadvantage of this technique is that usability is limited (depending on construction) as well as the overextension of materials required by this method. The resulting excess of material must often be thermally reduced, which in turn results in considerable disadvantages for the material strength and corrosion protection.

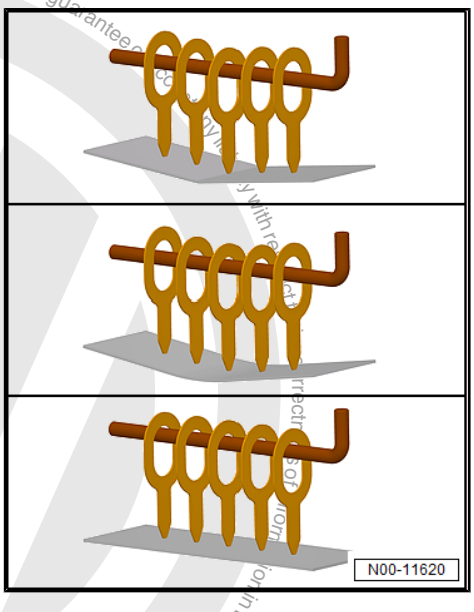
9.1.2 “Pressing” Bulge Correction Procedure, without Paint Damage

This dent removal method that does not cause paint damage is mostly used for minor parking and hail damage. Here the dent is softly pressed outward from the inside. The pressing is done circularly around the center of the dent in multiple stages, so that the paint can also be reshaped without a formation of cracks.

A - Pressing Set Example

9.1.3 “Exterior Dent Corrections / Pulling” Dent Removal Procedure

The exterior dent removal method is used as a bonding technique without damage as well as a method with paint damage, due to pulling aids being attached. This method selection therefore depends on the type of damage. For both procedures, the dent is pulled out of the panel from the outside. The long reshaping process significantly reduces the tension in the material structure. It is also referred to as “soft” or “no-shock” reshaping.



Advantages of these bulge removal methods:

- Overstretching of material is reduced
- Minimal corrosion protection damage.
- Minimal disassembling of the vehicle.
- Maintains the original joint (compared to component replacement).

9.2 Dent Removal Procedures, Aluminum Panel

Note

Cover aluminum parts when sanding or welding steel parts. If steel shavings get onto aluminum, remove them immediately because they can cause contact corrosion.

WARNING

Use separate tools for steel or aluminum.

Recommendation: Aluminum tool kit in the tool cart (refer to Workshop Equipment Catalog)

The dent removal techniques for aluminum components are not fundamentally different than those for steel components. However, due to the different material properties, several points must be noted:

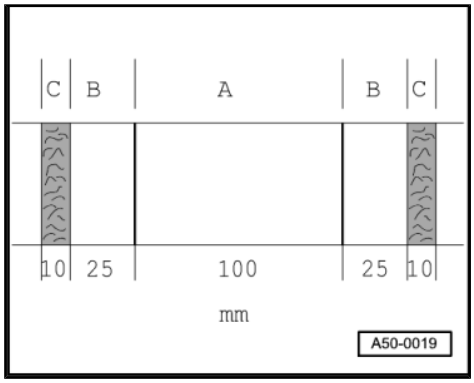
- Aluminum has a larger risk of stretching than steel.
- Sharp-edged and hard dent removal tools (for example, steel hammer) should be avoided and should be replaced with plastic, wood or aluminum hammers.
- In contrast to steel, dent removal procedures on aluminum panels starts at the middle of the dent.
- If the material stretches, this can be corrected by applying heat and retracting.

WARNING

Do not exceed the maximum heat of 150° C (302 °F) during retraction; otherwise, the component may become damage.

Note

Replace the part if a tear forms when removing dents.



Controlling Temperature When Heating

No tempering colors can be recognized when heating aluminum. Therefore, the temperature must be determined using thermo-strips.

Thermo-strips change color at specific temperatures.

A - Warming area

B - Free zone

C - Thermo-strips

9.3 Metal and Aluminum Body Filler, Handling

Using metal and aluminum body filler has many advantages:

- Very good adhesive properties on bare surfaces
- Higher coat strengths are possible than with polyester body filler.
- When handles correctly, there is a low tendency of “shrinking” or “sagging”.
- Due to the low application of heat, they can also be used in areas with adhesive.
- No visible marks in the overlapping areas.

Note

Only approved body filler materials may be used.

WARNING

- ***Note the handling information on the containers.***
- ***Adhesive residue or similar material must be completely removed from the joints before applying the body filler.***
- ***The surface temperature must be checked when drying with the infrared heater.***
- ***Self-regulating infrared heaters tend to have measurement errors on small surfaces, which can lead to component damage.***

9.4 Unleaded Tin, Handling

Note

- *Handling tin, even unleaded tin, is no longer permitted.*
- *To create a surface with correct contours, use the materials listed. Refer to*
  ⇒ “9.3 Metal and Aluminum Body Filler, Handling”, page 50 .

9.5 “Accurately Contoured Surface” Definition, Transfer to Paint Shop

The contoured surface is a surface with the dimensional accuracy of the edges and seams to the surface.

It is specified when:

- Any surfaces or parts that have been worked on, such as removing dents, welding or spackling, must be dry sanded with minimum P 80 grit sandpaper.
- The vehicle paint shop technician must then re-create the respective surface in a maximum of two steps.

Note

Only approved body filler materials may be used. Neither unleaded nor leaded alluvial tin is approved for any procedure.

10 Straightening Procedures on Vehicle Structure

10.1 Straightening

Body and floor assembly in series production are produced predominantly from cold-formed deep-drawing sheet metal. For this reason, reshaping accident damage should be carried out in the same way.

If the size of the damage does not allow it to be reshaped against the direction of damage, the damaged part must be removed after straightening the connecting surfaces.

10.2 Separation Cuts

Separating cuts that influence the fatigue strength of the body and the operational safety and road safety of the vehicle must be carried out according to the specifications of the applicable body repair manual.

10.3 Body Sub-Parts and Partial Sections

“Sub-parts” include sections of individual parts (for example, front and rear end points) that are delivered pre-cut from the replacement parts distribution center.

- In contrast to this, “partial sections” are to be cut out from “replacement parts”. In individual cases, work is to be performed exactly according to the methods described and represented in the body repair manual.
- Because the use of “sub-parts” or “partial sections” as well as special resources influence repair times, the special resources are included separately in the repair description.

11 Corrosion Protection

⇒ “11.1 Corrosion Protection on Attachments and Welded Parts”, page 53

⇒ “11.2 Sealing Cavities”, page 53

The standard corrosion protection should be reapplied after servicing with the materials specified by the manufacturer.

The corrosion protection used in production is described in the general and vehicle-specific Paint Manual.

11.1 Corrosion Protection on Attachments and Welded Parts

- Prime bare panel surfaces immediately after the repair.
- Holes must be deburred.
- Always apply welding primer/structure adhesive (according to the repair manual) to both sides of the welding flange.
- Prime the weld area on inside and outside before sealing.
- Apply sealant only to primed panels.
- Completely seal panel overlap, panel edges, butt joints, weld seams, etc. with sealant.
- Reproduce the paint structure as described in the paint manual.
- Restoring the underbody protection with long-term underbody protective material.
- Apply protective material to all cavities in repair area after finish painting.
- Protective material must be completely applied on separation cuts (for example, in side panel).
- Open water drains after cavity sealant material dries.

11.1.1 Contact Corrosion

Contact corrosion can occur if incorrect connecting elements (bolts, nuts, washers, etc.) are used.

For this reason, only fasteners with a special surface coating are installed.

In addition, rubber or plastic parts and adhesive are made of materials that do not conduct electricity.

If there are doubts about the suitability of parts, use new parts.

11.2 Sealing Cavities

The corrosion protection used in production is described in the general and vehicle-specific Paint Manual.

WARNING

- *Before beginning the process, it is required to become familiar with the safety information sheet covering safety precautions and safety recommendations.*
- *Even if products are not subject to labels, the general safety precautions for chemical products must be followed.*

Note

Depending on the type of cavity being treated, the drying process may take more than several days. Sufficient ventilation must be ensured during the drying process.

Caution

- ***Function components such as brake and exhaust systems may not be sprayed.***
- ***Rubber and plastic components should likewise also not be sprayed.***

Cleaning

- Any dripping cavity sealant can be easily wiped away.
- Adhesive remover should be used to clean off any drips on material.
- For large surfaces, a steam blaster may be used for cleaning. Splashes on painted surfaces should be removed immediately.

12 Plastic Repair

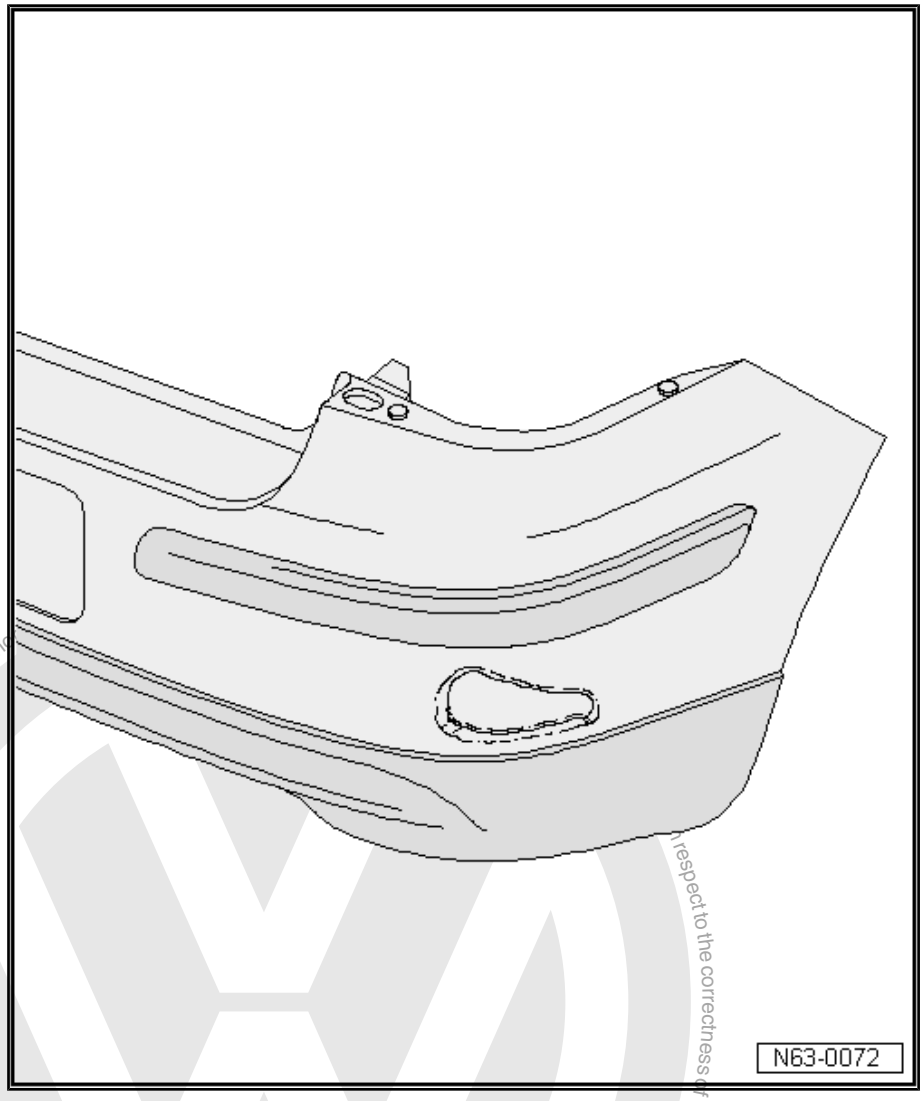
WARNING

Follow the general accident prevention tips. Do not repair safety-related components whose function can no longer be guaranteed after servicing, for example, those that absorb impact.

Plastic repairs with the plastic repair kit refer to servicing painted plastic body components such as the bumper and mirror housing. Before repairing, check carefully to see if the service can be performed and if it makes sense economically (repair/new part).

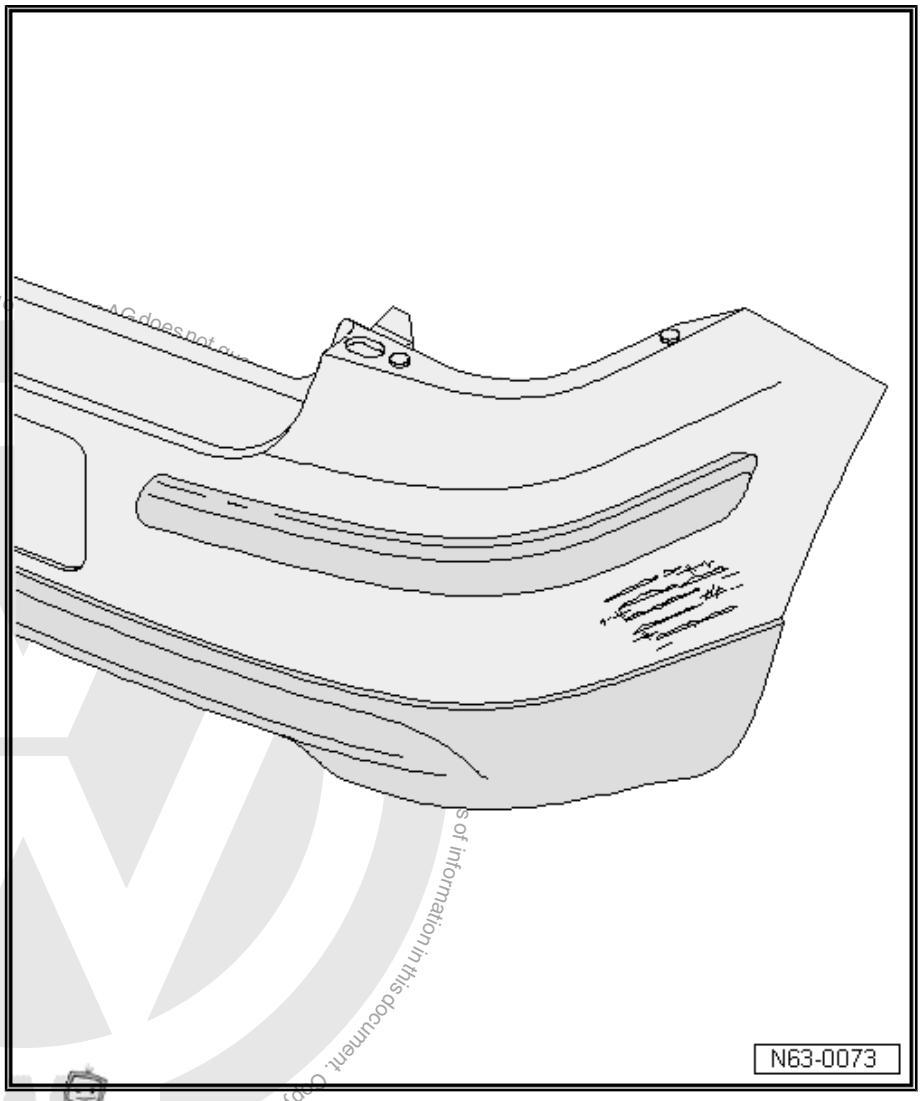
Plastic components with a structured surface can be serviced. However, the quality standard of the surface will not be at the same level as that of a new part.

12.1 Dents, Servicing



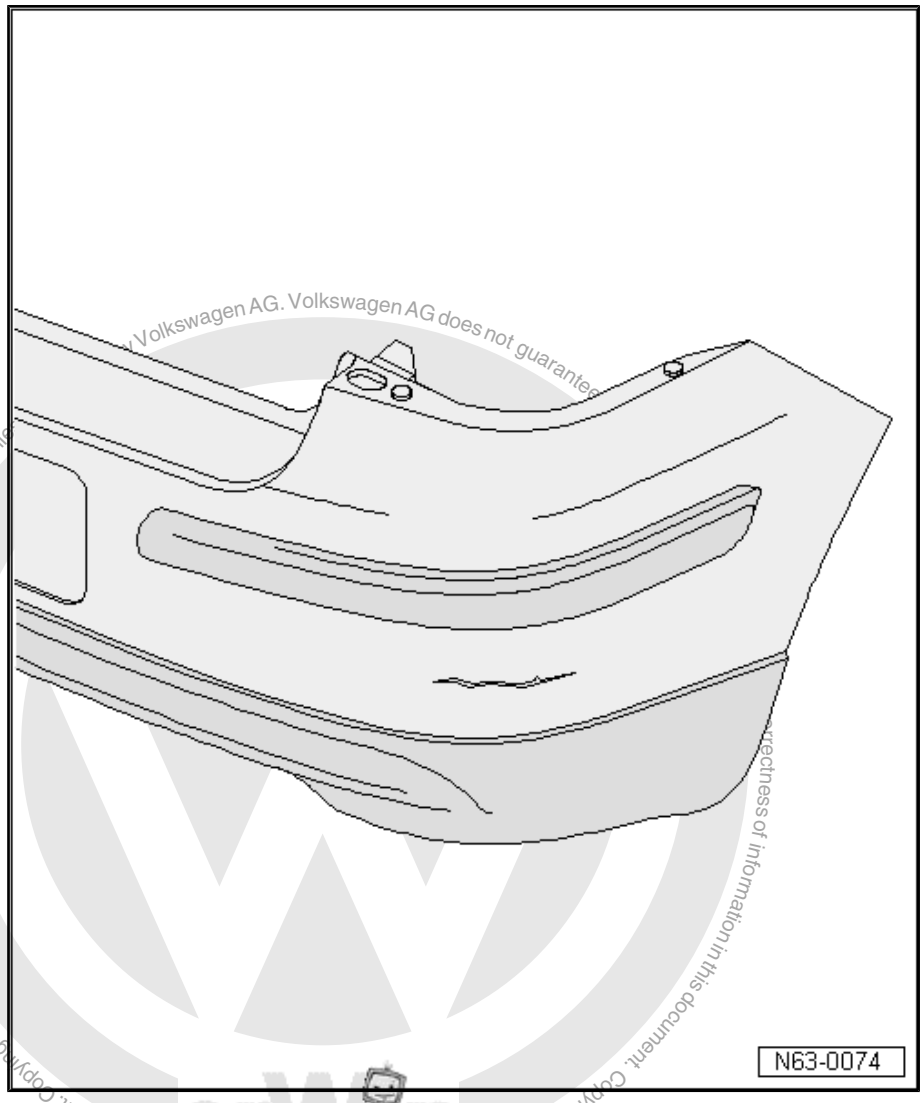
- First clean and dry the repair part.
- Warm the dented area with a hot air gun until it can be pressed out with a suitable tool.
- Now sand the dented area with 120 grit sandpaper.
- Then clean the repair area with cleaner. Drying time is five minutes.
- Now spray lightly with bonding agent and allow 10 minutes drying time.
- Now any uneven areas can be filled with adhesive and smoothed out with a spatula.
- Curing can be accelerated with an infrared heater. Set it for 15 minutes at 60°-70 °C (140 °F - 158°F).
- Now sand the repair location down with 120 grit sandpaper.
- Now remove the sanding dust.
- Now spray lightly with bonding agent and allow 10 minutes drying time.
- Create the paint structure according to the paint repair manual.

12.2 Scratches, Servicing



- First clean and dry the repair part.
- Remove stuck material with 80 grit sandpaper.
- Then clean the repair area with cleaner. Drying time is five minutes.
- Now spray lightly with bonding agent and allow 10 minutes drying time.
- Now any uneven areas can be filled with adhesive and smoothed out with a spatula.
- Curing can be accelerated with an infrared heater. Set it for 15 minutes at 60°-70 °C (140 °F - 158°F).
- Now sand the repair location down with 120 grit sandpaper.
- Now remove the sanding dust.
- Now spray lightly with bonding agent and allow 10 minutes drying time.
- Create the paint structure according to the paint repair manual.

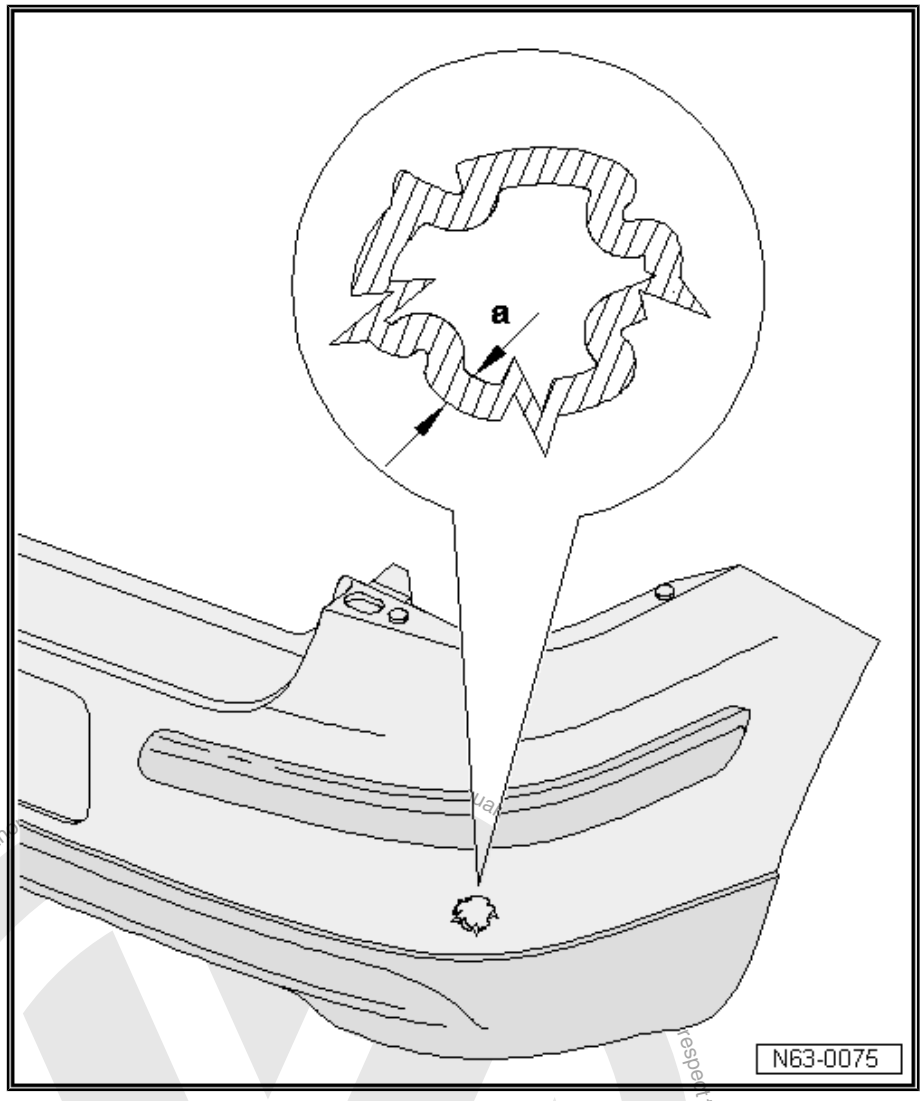
12.3 Cracks, Servicing, Up to 100 mm Long



- First clean and dry the repair part.
- Uneven areas can be removed through expanding by drilling the crack (5 mm) and sanding it in a V-formation.
- Then clean the repair area with cleaner. Drying time is five minutes.
- Now spray lightly with bonding agent and allow 10 minutes drying time.
- First, install a reinforcement mat on the back of the repair part using adhesive so that it overlaps the damaged parts by at least 20 mm.
- Curing can be accelerated with an infrared heater. Set it for 15 minutes at 60°-70 °C (140 °F - 158°F).
- Then, the front side of the sanded area can be filled with adhesive and smoothed with a spatula.
- Curing should be accelerated on the front side with the infrared heater as explained earlier.
- Now sand the repair location down with 120 grit sandpaper.

– Now remove the sanding dust.
– Now spray lightly with bonding agent and allow 10 minutes drying time.
– Create the paint structure according to the paint repair manual.

12.4 Holes, Servicing, Up to 30 mm Diameter



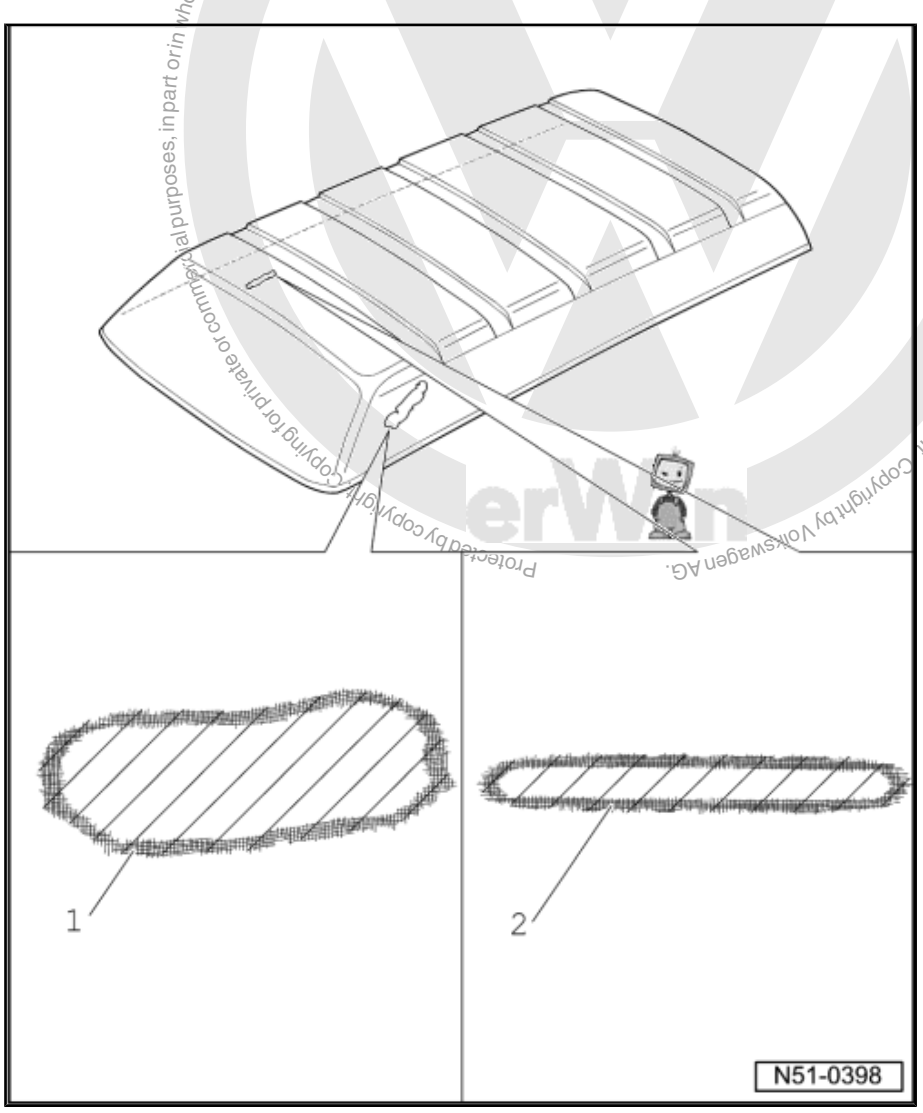
– First clean and dry the repair part.
– Using 120 grit sandpaper, sand the repair location in a funnel shape 10-20 mm, dimension a.
– Now spray lightly with bonding agent and allow 10 minutes drying time.
– Then rough up the area with 120 grit sandpaper.
– Then clean the repair area with cleaner. Drying time is five minutes.
– Now spray lightly with bonding agent and allow 10 minutes drying time.
– First, install a reinforcement mat on the back of the repair part using adhesive so that it overlaps the damaged parts by at least 20 mm.

- Curing can be accelerated with an infrared heater. Set it for 15 minutes at 60°-70 °C (140 °F - 158°F).
- Then, the front side of the sanded area can be filled with adhesive and smoothed with a spatula.
- Curing should be accelerated on the front side with the infrared heater as explained earlier.
- Now sand the repair location down with 120 grit sandpaper.
- Now remove the sanding dust.
- Now spray lightly with bonding agent and allow 10 minutes drying time.
- Create the paint structure according to the paint repair manual.

12.5 Plastic Repair (GFK)

⇒ “12.5.1 Crack Repair Procedure, Servicing”, page 61

⇒ “12.5.2 Surface Damage Repair Procedure, Servicing”, page 62



WARNING

Follow the general accident prevention tips. Do not repair safety-related components whose function can no longer be guaranteed after servicing, for example, those that absorb impact.

1- Crack

- Fiber glass mat, polyester resin and hardener

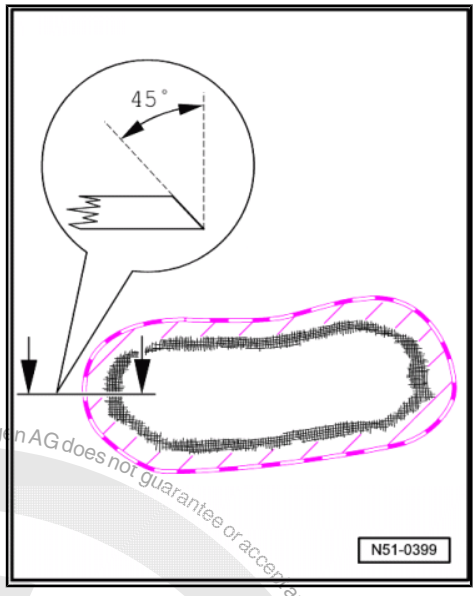
2- Surface damage

- Fiber glass reinforced polyester resin, hardener

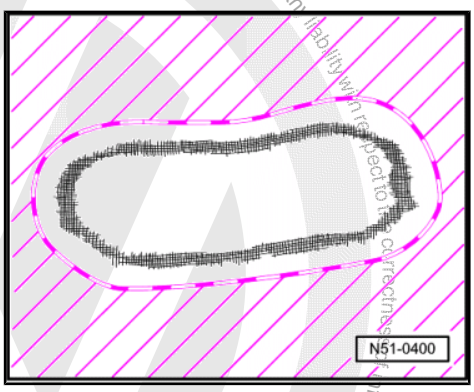
Note

Follow the usage instructions from the manufacturer when working with the materials.

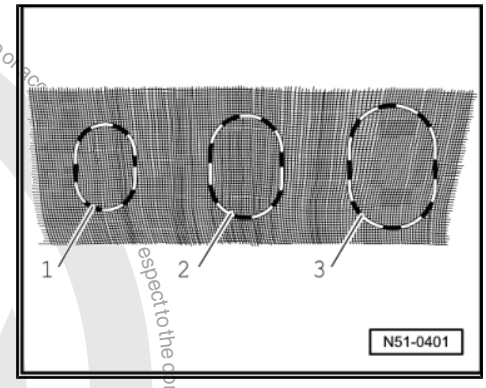
12.5.1 “Crack” Repair Procedure, Servicing



– Sand off the edge of the crack all around at approximately a 45° angle.



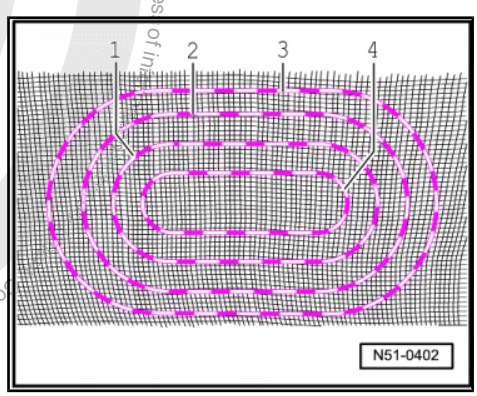
– Sand the surface down approximately 100 mm all around the crack -shaded area- with 150 grit sandpaper and clean with silicone remover.
– Cut the three fiber glass mats: -1- approximately 25 mm overlapping the crack, -2- approximately 50 mm overlapping, -3- approximately 75 mm overlapping.



Note

With larger cracks, creating a support from styrofoam is recommended. Wrap the styrofoam with plain, commercially available PE plastic film to avoid contact with polyester resin. Then secure the finished support on the inside of the crack with adhesive tape.

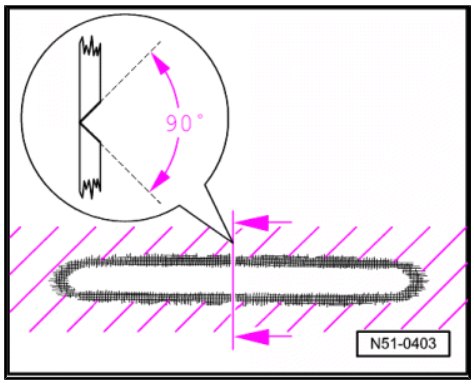
Install the fiber glass mats



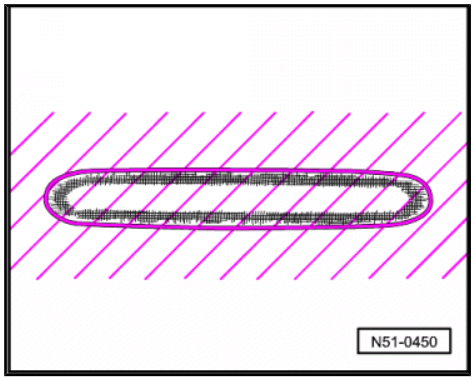
– Mix the polyester resin (follow the manufacturer's instructions).
– Apply the polyester resin lightly to the crack.
– Saturate the smallest fiber glass mat -1- with polyester resin and apply to the crack -4-.
– Remove air bubbles in the polyester resin with a pointed tool immediately after applying.
– After hardening, sand the material applied with 120 grit sandpaper.
– Clean the repair location with silicone remover.
– Repeat the procedure with the second -2- and third -3- fiber glass mats.

12.5.2 “Surface Damage” Repair Procedure, Servicing

– Grind down the surface damage in a V-shape.
– Sand the surface approximately 50 mm all around the surface damage -shaded area- with 150 grit sandpaper.



– Clean the repair location with silicone remover.
– Mix fiber glass reinforced polyester resin (follow the manufacturer's instructions) and apply it to the repair location -shaded area-.
– After curing, sand down the repair location and clean with silicone remover.



13 Glass Repair

⇒ “13.1 Windshield Repair”, page 63

13.1 Windshield Repair

⇒ “13.1.1 Requirements”, page 63

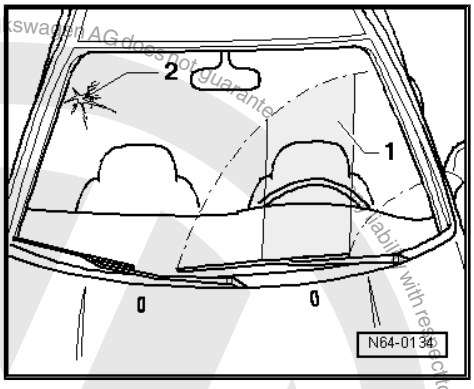
⇒ “13.1.2 Repair Description”, page 64

Aside from replacing bonded windshields, there is the less expensive option of repairing a windshield that has been damaged by a stone, under certain conditions.

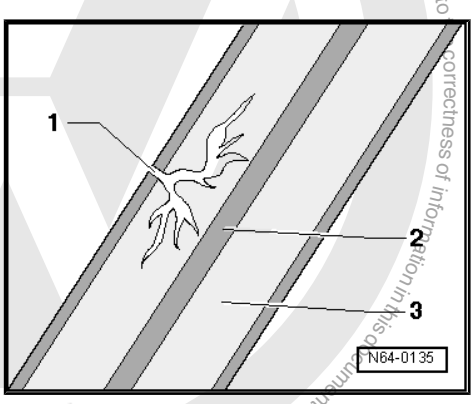
Tinted windshields, windshields with colored liners or tinted glass, and windshields with a heat function can also be repaired, because the tint and heat are emitted by the PVB interlayer.

Repairing the windshield is preferred to replacing it under the following conditions.

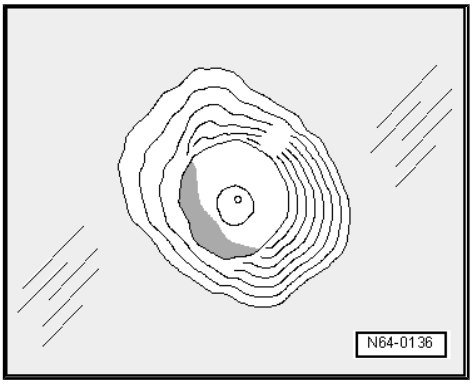
13.1.1 Requirements



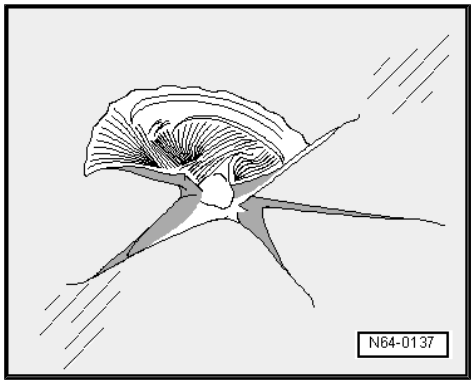
- The damage location must not lie within the driver's direct field of vision -1-. This field corresponds to a strip approximately 29 cm wide (DIN A4 format across) central to the driver's line of sight in direction of travel, bordered above and below by the windshield washer field.
- Cracks radiating out from the damage location -2- must not be longer than 50 mm and/or continue outward into the peripheral area.
- The diameter of the point of impact -1- must not be larger than 5 mm.
- The intermediate foil -2- or interior glass -3- must not be damaged.
- There must not be any dirt or moisture penetrating into the lower area of the crack.
- Therefore, the date of damage should not date back very long.



The following damage may be repaired as long as it is not in the field of vision or in the peripheral areas of the windshield:

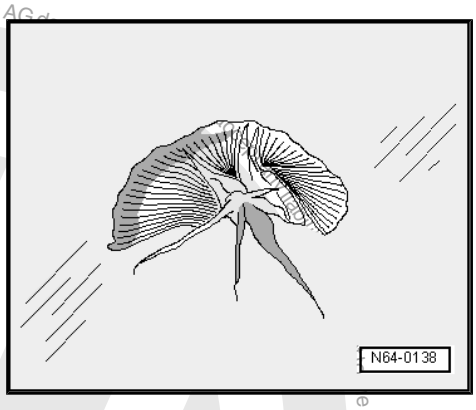


Bullseye



Combination Break

Stone and Crack



13.1.2 Repair Description

Use the repair procedure from the instructions for the repair kit approved in workshop equipment.

- Repairs should not take place in direct sunlight.
- The repair location must be approximately room temperature.
- The work area must be protected against moisture.

Note

- *After the repair, the vehicle is ready to operate again without any waiting time.*
- *Traces of fractures cannot be removed completely with many types of breaks but they do not affect the results of the repair.*
- *After repair, the window is as strong as normal and further cracks are prevented by the molded and hardened plastic resin. The hardened resin is colorless and has the same refractive index as glass.*

14 Thread Repairs

⇒ “14.1 Thread Repairs on Safety-Related Components”, page 65

If damaged threads are repaired, inserts with zinc-nickel coating must be used.

Steel shavings from drilling must be removed completely.

Only replace threaded pins with original parts.

Damaged threads can be repaired with thread inserts with zinc-nickel coating.

WARNING

Contact corrosion is prevented only by using this coating.

Some threads are already supplied with thread inserts at the factory.

14.1 Thread Repairs on Safety-Related Components

Depending on the vehicle-specific structure characteristics, repairs to threads such as axle or seat belt mounts are permitted are not feasible.

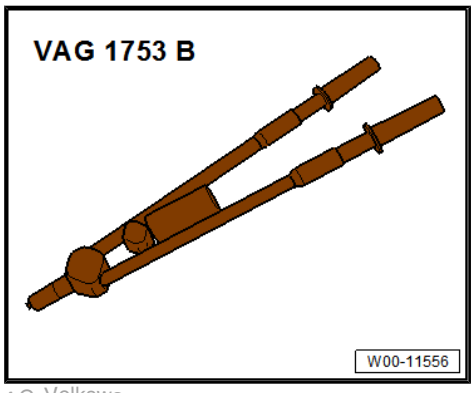
Note

Always refer to the vehicle-specific repair manuals for this.

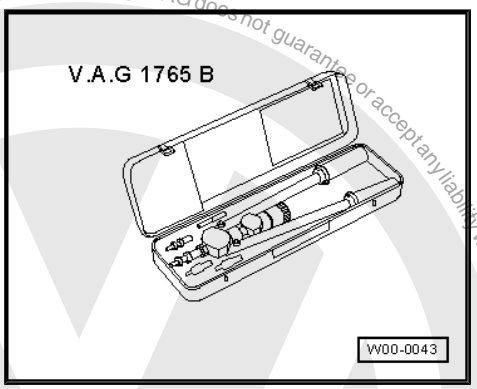
15 Special Tools

Special tools and workshop equipment required

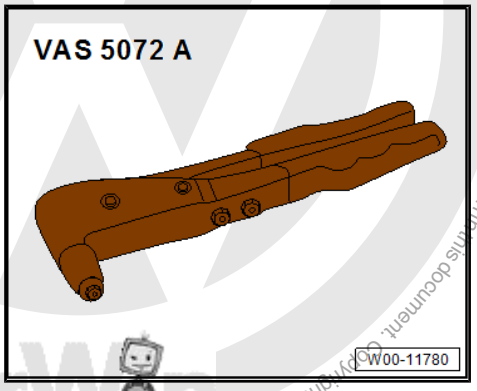
- Pop Rivet Pliers - VAG1753B-



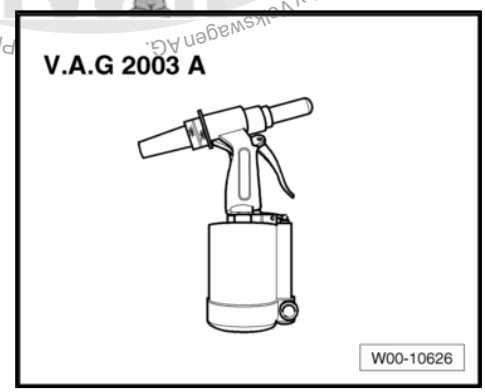
- Pop Rivet Pliers - VAG1765C-



- Pop Rivet Nut Pliers - VAS5072A-

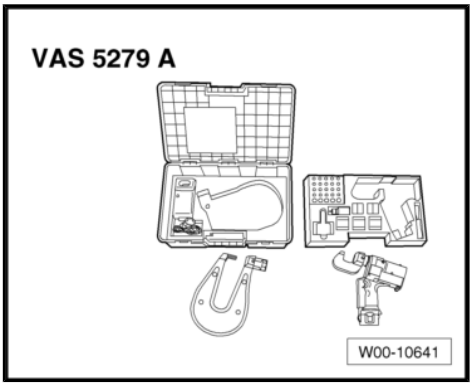


- Pneumatic Pop Riveter - VAG2003A-



- Pneumatic Rivet Gun - VAS6759-

- Rechargeable Riveter - VAS5279A-



- Rechargeable Riveter - VAS843 001-
- Pneumatic-Hydraulic Riveter Set - VAS6790-
- Compact Riveting Device - VAS6792-
- FD Bolt Socket - VAS852007A-
- Miracle Alurepair Plus-System - VAS852 001-

16 Revision History

DRUCK NUMBER: 00653201021

Factory Edition	Edit Edition	Job Type	Feedback	Notes	Quality Checked By
06.2017	06/25/2018	Factory Update	N/A		Joe Y.

Cautions & Warnings

Please read these WARNINGS and CAUTIONS before proceeding with maintenance and repair work. You must answer that you have read and you understand these WARNINGS and CAUTIONS before you will be allowed to view this information.

- If you lack the skills, tools and equipment, or a suitable workshop for any procedure described in this manual, we suggest you leave such repairs to an authorized Volkswagen retailer or other qualified shop. We especially urge you to consult an authorized Volkswagen retailer before beginning repairs on any vehicle that may still be covered wholly or in part by any of the extensive warranties issued by Volkswagen.

- Disconnect the battery negative terminal (ground strap) whenever you work on the fuel system or the electrical system. Do not smoke or work near heaters or other fire hazards. Keep an approved fire extinguisher handy.

- Volkswagen is constantly improving its vehicles and sometimes these changes, both in parts and specifications, are made applicable to earlier models. Therefore, part numbers listed in this manual are for reference only. Always check with your authorized Volkswagen retailer parts department for the latest information.

- Any time the battery has been disconnected on an automatic transmission vehicle, it will be necessary to reestablish Transmission Control Module (TCM) basic settings using the VAG 1551 Scan Tool (ST).

- Never work under a lifted vehicle unless it is solidly supported on stands designed for the purpose. Do not support a vehicle on cinder blocks, hollow tiles or other props that may crumble under continuous load. Never work under a vehicle that is supported solely by a jack. Never work under the vehicle while the engine is running.

- For vehicles equipped with an anti-theft radio, be sure of the correct radio activation code before disconnecting the battery or removing the radio. If the wrong code is entered when the power is restored, the radio may lock up and become inoperable, even if the correct code is used in a later attempt.

- If you are going to work under a vehicle on the ground, make sure that the ground is level. Block the wheels to keep the vehicle from rolling. Disconnect the battery negative terminal (ground strap) to prevent others from starting the vehicle while you are under it.

- Do not attempt to work on your vehicle if you do not feel well. You increase the danger of injury to yourself and others if you are tired, upset or have taken medicine or any other substances that may impair you or keep you from being fully alert.

- Never run the engine unless the work area is well ventilated. Carbon monoxide (CO) kills.

- Always observe good workshop practices. Wear goggles when you operate machine tools or work with acid. Wear goggles, gloves and other protective clothing whenever the job requires working with harmful substances.

- Tie long hair behind your head. Do not wear a necktie, a scarf, loose clothing, or a necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.

- Do not re-use any fasteners that are worn or deformed in normal use. Some fasteners are designed to be used only once and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual - replace these fasteners with new parts where indicated, and any other time it is deemed necessary by inspection.

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Cautions & Warnings

- Illuminate the work area adequately but safely. Use a portable safety light for working inside or under the vehicle. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

- Friction materials such as brake pads and clutch discs may contain asbestos fibers. Do not create dust by grinding, sanding, or by cleaning with compressed air. Avoid breathing asbestos fibers and asbestos dust. Breathing asbestos can cause serious diseases such as asbestosis or cancer, and may result in death.

- Finger rings should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.

- Before starting a job, make certain that you have all the necessary tools and parts on hand. Read all the instructions thoroughly; do not attempt shortcuts. Use tools that are appropriate to the work and use only replacement parts meeting Volkswagen specifications. Makeshift tools, parts and procedures will not make good repairs.

- Catch draining fuel, oil or brake fluid in suitable containers. Do not use empty food or beverage containers that might mislead someone into drinking from them. Store flammable fluids away from fire hazards. Wipe up spills at once, but do not store the oily rags, which can ignite and burn spontaneously.

- Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use these tools to tighten fasteners, especially on light alloy parts. Always use a torque wrench to tighten fasteners to the tightening torque listed.

- Keep sparks, lighted matches, and open flame away from the top of the battery. If escaping hydrogen gas is ignited, it will ignite gas trapped in the cells and cause the battery to explode.

- Be mindful of the environment and ecology. Before you drain the crankcase, find out the proper way to dispose of the oil. Do not pour oil onto the ground, down a drain, or into a stream, pond, or lake. Consult local ordinances that govern the disposal of wastes.

- The air-conditioning (A/C) system is filled with a chemical refrigerant that is hazardous. The A/C system should be serviced only by trained automotive service technicians using approved refrigerant recovery/recycling equipment, trained in related safety precautions, and familiar with regulations governing the discharging and disposal of automotive chemical refrigerants.

- Before doing any electrical welding on vehicles equipped with anti-lock brakes (ABS), disconnect the battery negative terminal (ground strap) and the ABS control module connector.

- Do not expose any part of the A/C system to high temperatures such as open flame. Excessive heat will increase system pressure and may cause the system to burst.

- When boost-charging the battery, first remove the fuses for the Engine Control Module (ECM), the Transmission Control Module (TCM), the ABS control module, and the trip computer. In cases where one or more of these components is not separately fused, disconnect the control module connector(s).

- Some of the vehicles covered by this manual are equipped with a supplemental restraint system (SRS), that automatically deploys an airbag in the event of a frontal impact. The airbag is operated by an explosive device. Handled improperly or without adequate safeguards, it can be accidentally activated and cause serious personal injury. To guard against personal injury or airbag system failure, only trained Volkswagen Service technicians should test, disassemble or service the airbag system.

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Cautions & Warnings

- Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.

- Never use a test light to conduct electrical tests of the airbag system. The system must only be tested by trained Volkswagen Service technicians using the VAG 1551 Scan Tool (ST) or an approved equivalent. The airbag unit must never be electrically tested while it is not installed in the vehicle.

- Some aerosol tire inflators are highly flammable. Be extremely cautious when repairing a tire that may have been inflated using an aerosol tire inflator. Keep sparks, open flame or other sources of ignition away from the tire repair area. Inflate and deflate the tire at least four times before breaking the bead from the rim. Completely remove the tire from the rim before attempting any repair.

- When driving or riding in an airbag-equipped vehicle, never hold test equipment in your hands or lap while the vehicle is in motion. Objects between you and the airbag can increase the risk of injury in an accident.

I have read and I understand these Cautions and Warnings.

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