

Thatcham
Research

VEHICLE HEADLAMP REPAIR INSIGHT

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VEHICLE HEADLAMP REPAIR INSIGHT

1. Statement of Challenge

1.1 Cost

Over the course of the last 20 years, the cost of replacement headlamps has drastically increased. The main contributing factors causing this increase in cost are:

- › Advances in technology.
- › Inflation.
- › Availability of materials.

In some cases, the cost of a replacement headlamp is as much as 8% of the cost of the total vehicle value when new.

As a vehicle ages, the vehicle value depreciates and becomes increasingly disproportionate to the cost of new replacement parts. This can result in an un-economic repair being more likely in low severity scenarios of damage.

1.2 Sustainability in Repair

Sustainability is a key societal concern. The repair eco-system thrives on the ability to safely and efficiently:

- › Replace with new parts.
- › Replace with green parts.
- › Repair over replace.

Headlamps are one of the most commonly damaged components on a vehicle. Whilst factoring in the cost and availability of new parts, advances in technology, and the complexities in preparing/replacing parts, applying the correct level of diligence to safely and efficiently carry out a repair or replacement with new or with a green part is critical to maximising sustainability in repair.

1.3 Safety

Although Headlamp repair may initially seem like a simple process, there are many safety designs and features that complicate the work. The safe functionality of a headlamp is dependent on:

- › Structural integrity of the lamp and resilience to vibration, impacts and environmental changes.
- › Optical performance and beam patterns.
- › Reliable functionality of all light settings.
- › Correct operational parameters of the headlamps, confirmed with diagnostic equipment (when required).
- › Correct operational integration between the headlamps and other vehicle systems (such as the ECU) can be confirmed with diagnostic equipment (when required).



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CAUTION SHOULD BE APPLIED TO THE HEADLAMP BEAM SETTING, DUE TO THE VARYING COMPLEXITIES ACROSS DIFFERENT VMS. IN SOME CASES, SPECIFIC BEAM SETTING EQUIPMENT AND/OR DIAGNOSTIC EQUIPMENT IS REQUIRED. VEHICLES MAY NOT ALWAYS DISPLAY A DIAGNOSTIC TROUBLE CODE (DTC) LIGHT WHEN THE BEAM ALIGNMENT REQUIRES ADJUSTMENT. FURTHERMORE, INCORRECT STRUCTURAL REPAIRS TO HEADLAMP MOUNTINGS AND LENSES COULD AFFECT ITS RESILIENCE TO ROAD USE, LEADING TO FURTHER FAILURES, INCLUDING PEDESTRIAN IMPACT SAFETY.

2. Scope

This document is intended to give industry best practice guidance to support the following audiences when applying diligence to repairing, replacing with new, or the supply and use of green part vehicle headlamps.

- > Repair sector
- > Insurer (claims/engineering)
- > Green part supplier

3. Headlamp Overview

3.1 Evolution of Headlamp Technology

As headlamp technology has evolved, so has the integration and therefore dependency between a vehicle’s headlamps and other components and systems on the vehicle.

Note: headlamp technology, fitment, functionality, and integration will vary across vehicle manufacturers.

Show the table of examples:

3.2 Pedestrian Safety

Pedestrian safety elements often feature within the structure of a vehicle headlamp. An example of this safety feature is often engineered into the headlamp mounting brackets that attach the headlamp to the vehicle. This feature is often identified as a perforated break zone that is designed into the headlamp mounting bracket(s), these perforations are designed to break at a pre-defined impact load such as the upper leg of a pedestrian.

See the Euro NCAP Crash & Safety Tests of VW ID.4 2021 video here:

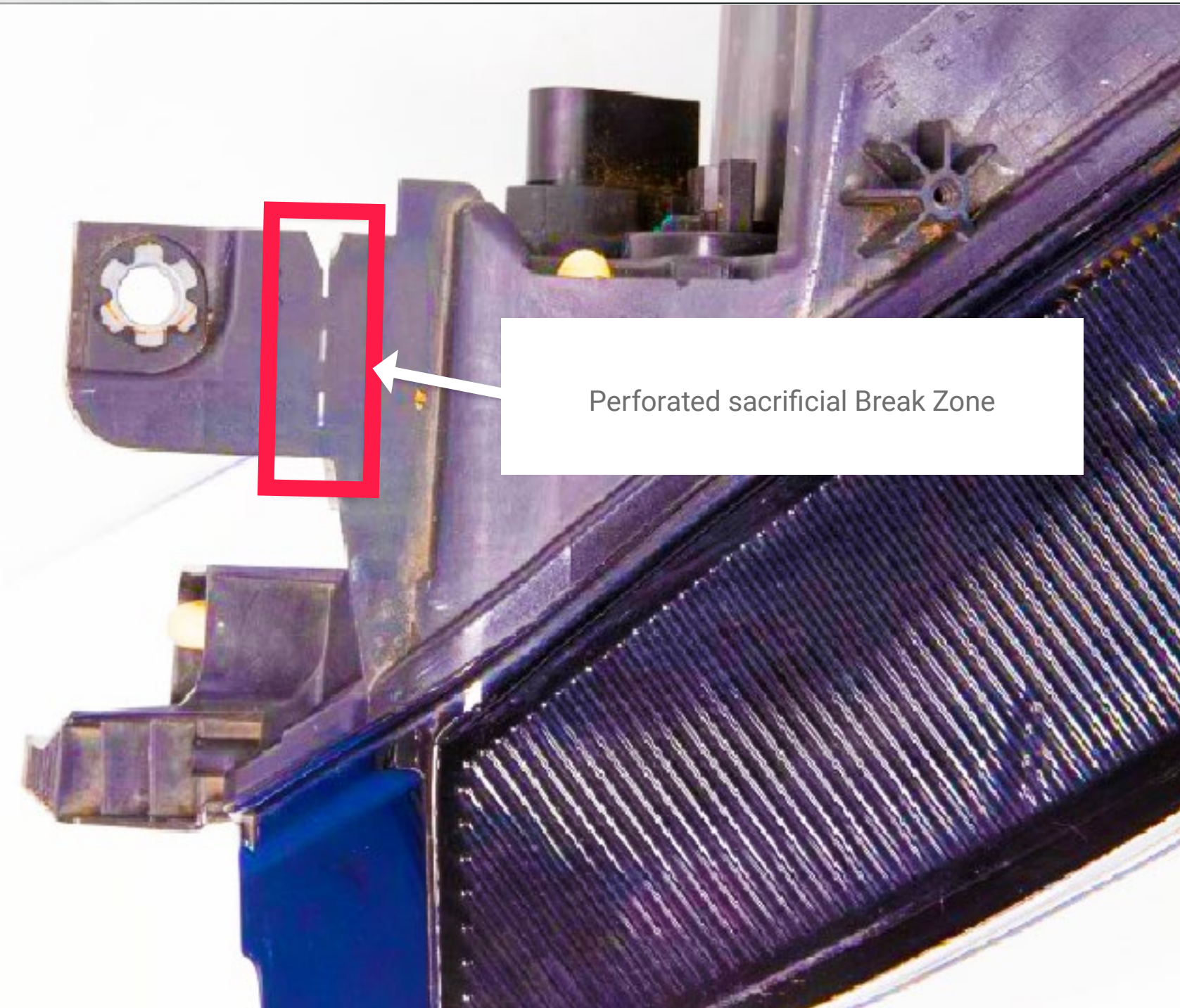


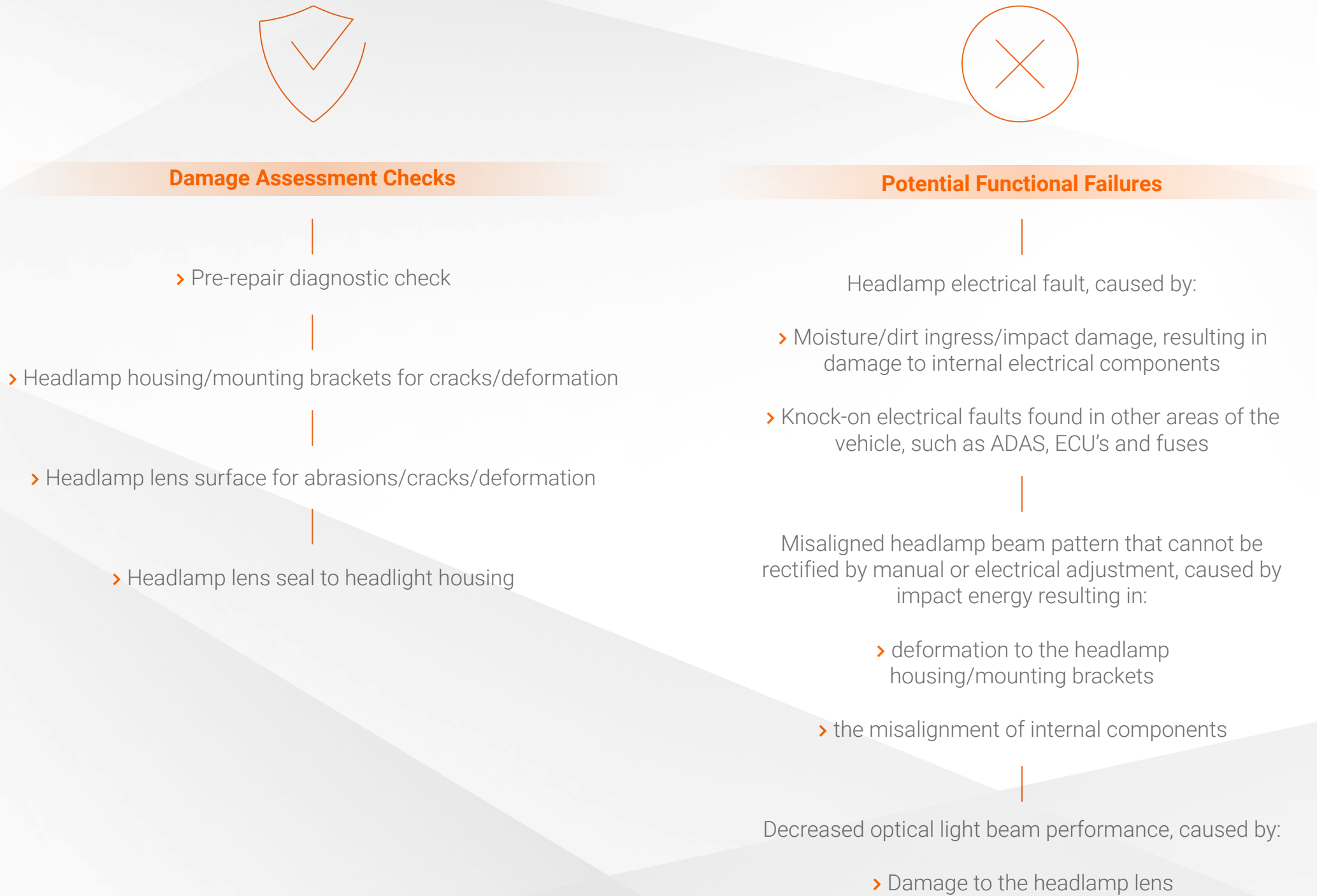
Figure 1: VW ID-4 Headlamp

4. Repair and Replacement

4.1 Damage Assessment

With any repair operation, accurate damage assessment is critical to performing a safe, cost-effective repair. The table below provides examples of the checks to headlamps that should be carried out at the damage assessment stage of repair.

Examples of the potential failures that can occur are detailed in the far right graphic:



4.2 Headlamp Replacement

4.2.1 New parts

The requirement to code, initialise or calibrate new headlamp units is becoming more common. Repair key to key times can extend if this requirement is not identified at the beginning of the repair process. The VM diagnostic equipment is often required to perform these operations.

Headlamp beam alignment shall be performed post-repair. This can also require VM diagnostic equipment and specialist headlamp beam alignment equipment.

Note: If the VM repair information does not mention the requirements above, the assumption that they are not required and should not be made. If unsure, it may be worth contacting the VM dealer network to confirm.

4.2.2 Green parts

Utilising green part suppliers for replacement headlamps can be beneficial to a sustainable repair ecosystem. Some tips to utilise the services effectively:

- › Buy from suppliers that carry out robust quality checking, damage assessment and grading, look for suppliers certified by the Vehicle Recyclers Association (VRA).
- › A green part with a damaged headlamp mounting bracket can still be used if there is a headlamp mounting bracket repair kit available from the VM.
- › Ensure that the headlamp you are buying is correct for the vehicle being repaired.
- › Ensure that the headlamp you are buying can be coded, initialised or calibrated to the vehicle being repaired.
- › Repairers should be aware that part warranties/ guarantees may differ by green part supplier. It is important that the consumer is made aware of the differences when comparing to part warranties with new, OEM headlamps.

4.3 Headlamp Repair

The repair of vehicle headlamps can be beneficial in terms of:

- › Parts cost saving when compared to replacing with new parts.
- › Unavailability of new parts within a reasonable period.
- › Re-use of original parts can avoid OEM part coding processes.

The following diligence must be applied to any 'repair vs replace' decision:

- › Damage assessment checks.
- › Agreement with work provider/customer.
- › A diagnostics procedure is completed, and any codes checked.
- › Correct repair procedures are identified and adhered to.
- › Correct headlamp functionality and alignment is confirmed post-repair.
- › Correct headlamp functionality with associated ADAS where applicable post-repair.

4.3.1 Headlamp Mounting Bracket Replacement

Research carried out by Thatcham Research has found that 65% of the UK's top 10 selling vehicle manufacturers offer a headlamp mounting bracket repair kit. These repair kits are designed to replace the sacrificial headlamp mounting bracket(s) in some scenarios of damage.

The vehicle manufacturer's supplied repair kits ensure the correct performance of the headlamp post-repair. Diligence must still be applied to confirm that the damage to the headlamp is isolated to the headlamp mounting bracket being replaced.

Availability of the VM repair kits can be identified via:

- › Vehicle manufacturer electronic parts catalogue (dealer parts supply network).
- › Escribe parts information. - available when Thatcham Research complete the relevant vehicles part project.
- › Estimating systems.

An indication as to whether a headlamp has been designed to accommodate a repair kit can also be made via an initial visual observation. Figure 2 shows the screw holes that are generally used to attach the new replacement mounting bracket:

Where available, vehicle manufacturer repair methods provide instruction to fit the headlamp mounting bracket repair kit correctly. The Vehicle Manufacturer repair methods can be sourced via Escribe. Some Vehicle Manufacturers also publish guidance for permitted/prohibited headlamp repair. This information, when available, is published in Escribe within the Vehicle Manufacturer repair methods.

Below are examples of best practices to consider alongside any vehicle manufacturer repair information when replacing a headlamp mounting bracket:

Recommendations:

- › When fitting replacement brackets, it is important to follow official methods and guidance.
- › If cutting plastic, ensure that any swarf or debris is cleaned from the mating parts.
- › Once new brackets are fitted, a beam alignment process must be carried out via the manufacturer's specification.
- › Carry out work on a solid, padded bench to protect the lens of the lamp.

You should not:

When fitting screws into the screw fixing locations (fig.2), should not attempt to remove and replace the screws multiple times, as this can permanently damage the thread.

Change how the lamp is mounted to the car body, either by using different screws, washers, or spacers.

Reinforce the bracketry in any way. E.g., using adhesives, additional reinforcing material, or plastic/metal that does not match the original material.

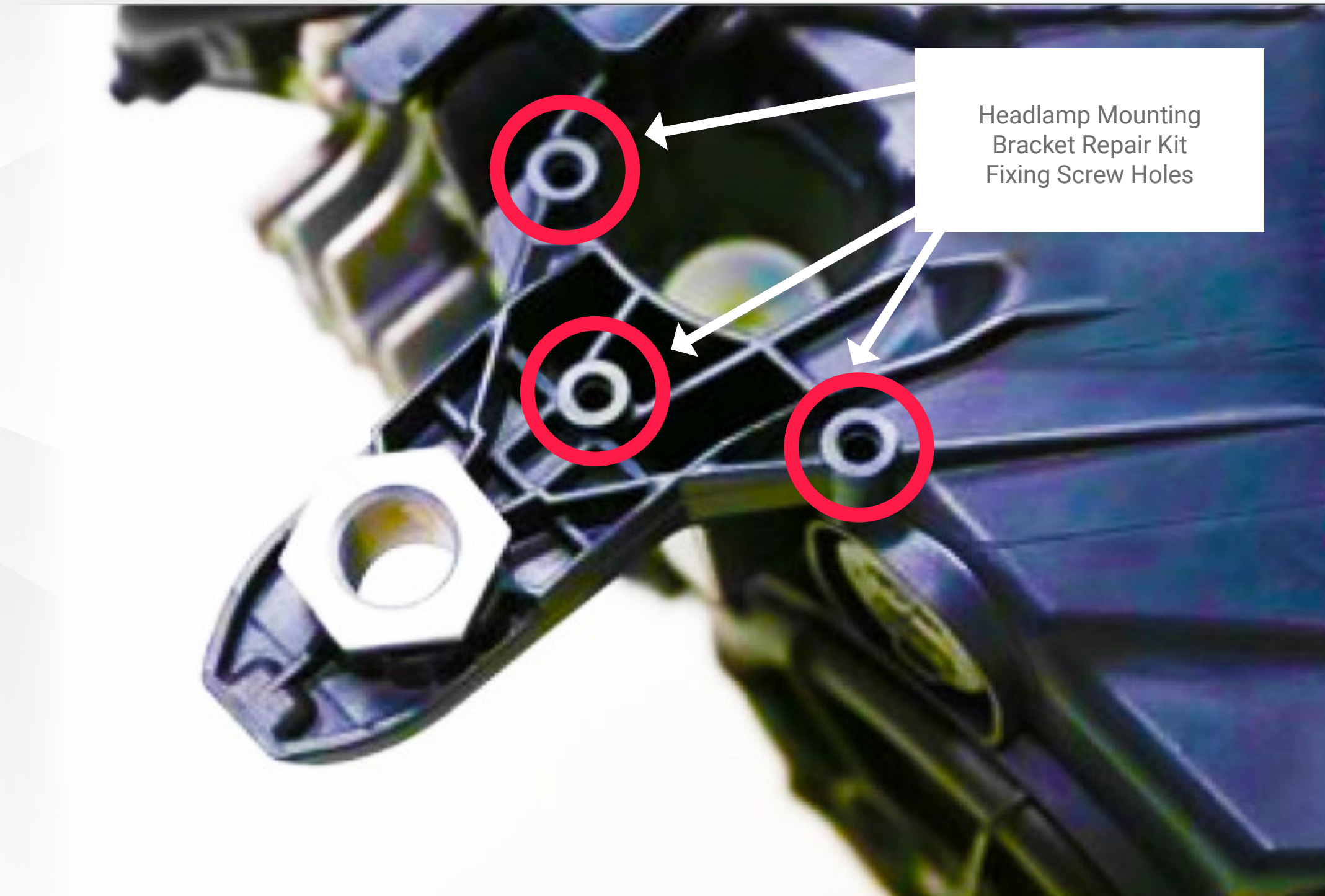


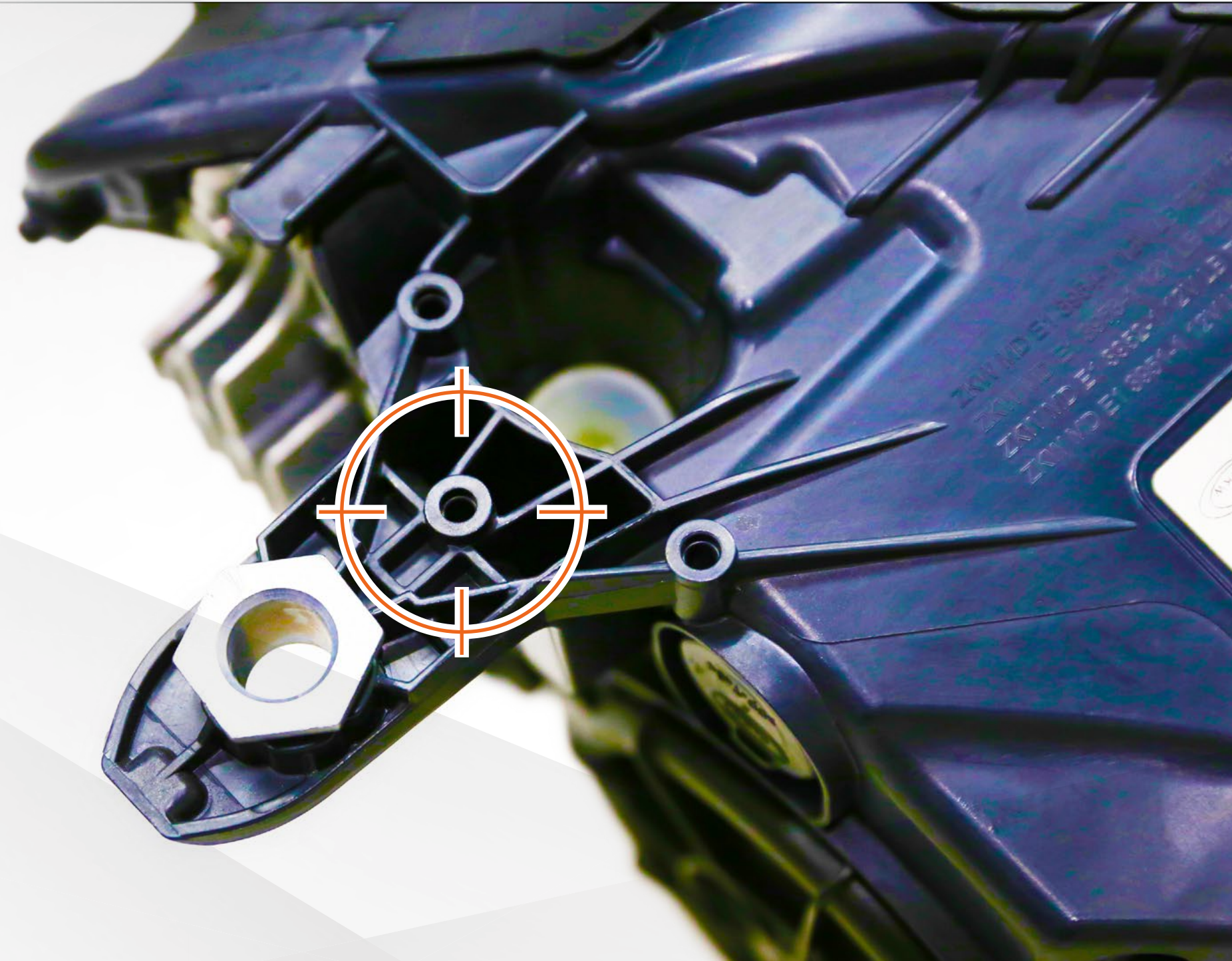
Figure 2: Screw Fixing Locations

4.3.2 Headlamp Mounting Bracket Repair

Despite a considerable number of Vehicle manufacturers currently not offering headlamp mounting bracket repair kits, a repair to a broken headlight mounting bracket may still be a viable option. There are many things to consider when making the right decision that will not adversely affect the performance of a vehicle's headlamp.

Some points to consider when planning a repair to a headlamp mounting bracket:

- › Headlamps are vigorously tested in development to ensure that they can withstand environmental elements and vibration.
- › The correct alignment of a vehicle headlamp is critical to the manufactured performance. Ensure that a headlamp beam alignment check is performed when removing/refitting and or repairing a vehicle headlamp.
- › Pedestrian safety features often form part of the structural design of a vehicle headlamp.



Headlamp bracket designed to fail

Table 2 gives examples of typical damage scenarios, common plastic repair techniques used in the industry and the potential failures that may occur as the result of a headlamp mounting bracket repair being carried out:

Damage Scenarios	Repair Techniques	Potential failures
Headlamp mounting bracket(s) fractured or separated: > At perforated break zone (refer to 3.2 pedestrian safety) > Outside of the perforated break zone > Fixing location	Recommended: > Hot fusion - plastic welding > Hot fusion nitrogen plastic welding Not recommended: > Hot staples > Metal mesh or other metal reinforcements > Plastic mesh	Compromised pedestrian safety elements through Increased strength of the mounting bracket(s), caused by: > Any repair that removes a perforated break zone > Any repair that alters the profile of the substrate > Any repair that alters the properties of the substrate Compromised environmental and vibration properties through decreased strength of the mounting bracket(s), caused by: > Any repair that alters the profile of the substrate > Any repair that alters the properties of the substrate Incorrect alignment of the headlamp caused by: > Any repair that alters the profile of the substrate > Any repair that alters the fixing locations

Table 2: Damage Scenarios, Repair Techniques and Potential Failures

Note: This information is best practice, and a repairer should always refer to Vehicle Manufacturer repair information in the first instance.

Hot fusion nitrogen plastic welding is recommended for repairing a fractured or separated headlamp mounting bracket*. The reasons for this are as follows:

The nitrogen acts as a shielding gas around the weld pool, emitting any oxidation. This helps to ensure that the substrate retains its original properties in the repaired area.

The broken part can be repaired to the same thickness and contours as the original.

Note: It is imperative that the base material type being repaired is identified, and that the plastic welding rod being used is confirmed to be the same material type as the base material.

4.3.3 Headlamp Housing Repair

Repairs to the headlamp housing/casing are generally prohibited. This is because any damage to the headlamp housing may result in a compromise to the airtight seal of the headlamp, resulting in damage to internal electrical components. Damage to the headlamp housing may also adversely affect the structural integrity of the headlamp.

Furthermore, any debris or swarf material that could be trapped inside the lamp could result in failure of the electronics or optics.

4.3.4 Headlamp Lens Replacement

Thatcham Research is seeing a developing trend with some Vehicle Manufacturers providing a solution to replace a damaged headlamp lens. One example is Toyota. Thatcham Research anticipates that this trend may develop further with other Vehicle Manufacturers introducing alternative solutions across the car parc.

The availability of replacement lenses and the associated Vehicle Manufacturer's repair information can be identified as detailed in Section 4.2: Headlamp Replacement.

It is imperative that if replacing a damaged headlamp lens, the following diligence is applied:

- Damage assessment checks.
- Vehicle Manufacturer or other recognised repair information is followed.
- Vehicle Manufacturer consumables and tooling are utilised.

* When a repair is deemed acceptable.

Shown in the next column are examples of best practices to consider alongside any Vehicle Manufacturer's repair information when replacing a headlamp lens:

Recommendations:

- › When removing the lens, it is important to follow the manufacturer's guidance and methods.
- › Perform work with clean, rubber gloves.
- › Take extra care when loosening plastic clips, as these tend to be fragile. If the clips break, then you may have to replace the entire lamp.
- › When heating the lamp, work slowly, covering the entire aperture of the lamp seal.
- › Ensure that the lamp internals are completely free of dust or contamination.
- › Remove any dust or debris that may have entered the lamp before sealing the lens. If possible, use an anti-static airline.
- › Use anti-static mating, tools and PPE where possible as Electrostatic Discharge (ESD) can damage the fragile internal electronics in the lamp.
- › Use a solid bench with a padded material to protect the lamp when removing the lens.
- › It is critical to the function of the lamp, that the lens is fitted so that it creates an air-tight seal. Air leaks in the lens can cause water ingress and condensation which will lead to damage of the lamp.

You should not:

Apply direct heat to a concentrated segment of the lamp. In many cases, the Vehicle Manufacturer's repair method will describe a maximum temperature before the plastic may deform.

Buff, polish or sand a headlamp lens. This will likely destroy its UV coating and can affect optical performance.

Attempt to repair cracked or chipped lenses.

Scratch or mark any of the internal components, as this may affect optical performance.

Reuse parts of the lamp that are single-use. E.g., the lens gaskets. This should be highlighted in the Vehicle Manufacturer repair methods.

Handle the internal components of the lamp with bare hands.

Carry out processes that may create dust or debris within close vicinity of an open lamp.

Allow dust or dirt to enter the lamp before sealing the lens.

Pinch or pull electrical harnesses inside the lamp upon disassembly and reassembly.

4.3.5 Headlamp Lens Repair

There are many products and processes available on the market to repair and refinish headlamp lenses. This type of repair should be approached with caution. Before carrying out any repair to a vehicle headlamp lens, always check the following:

- › Vehicle Manufacturer permitted/prohibited repair information (if available).
- › The suitability of the product or process being used with the product supplier for the headlamp being repaired.
- › Agreement with work provider/customer.

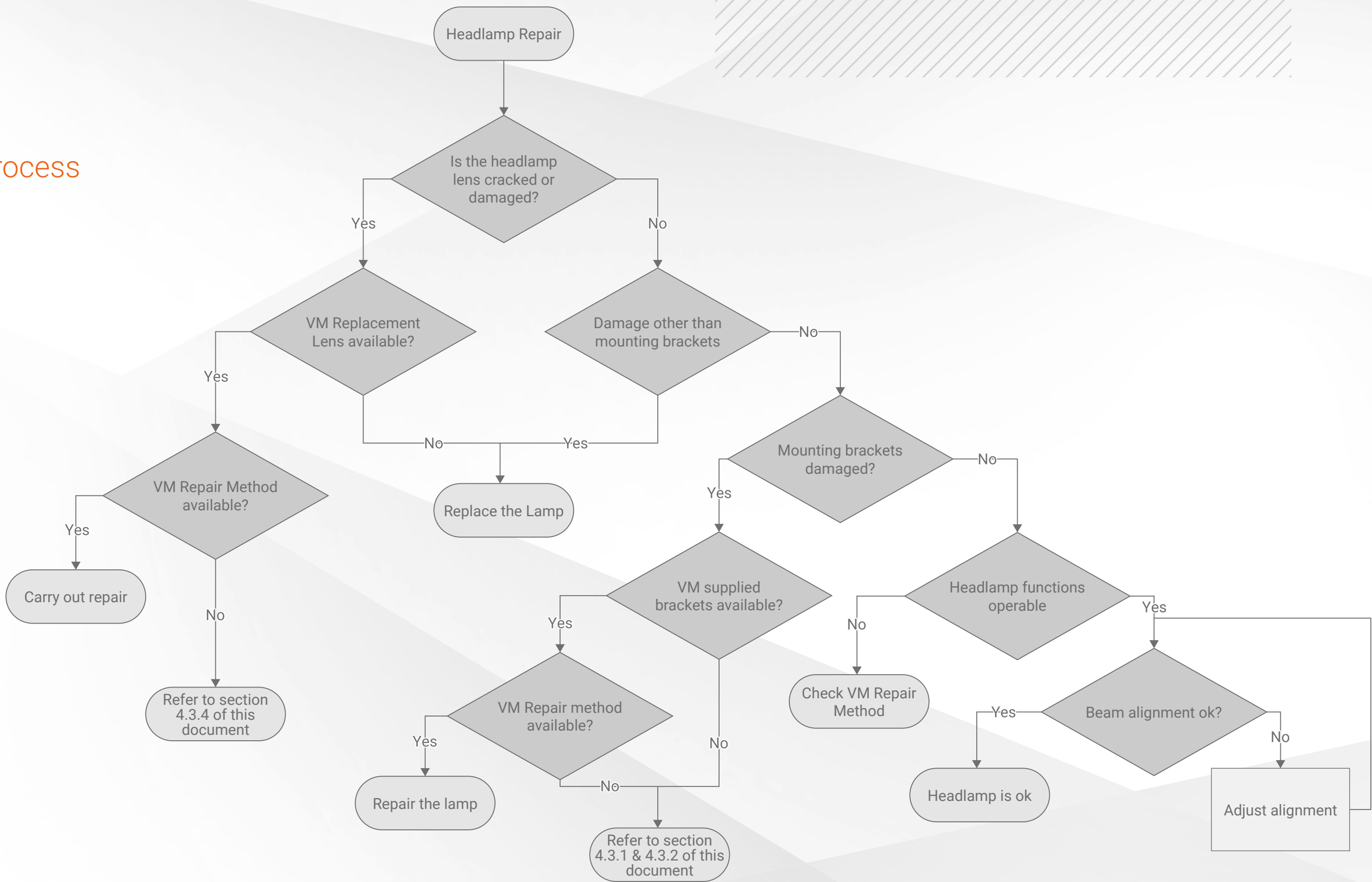
Table 3 details some potential failures which may occur as a result of a headlamp lens repair:

Note: optical light beam performance is critical to safety, in particular with headlamps that feature adaptive and advanced LED functionality.

Repair Type	Potential Failures
Sanding / Polishing / buffing of lens	› Decreased optical light beam performance › Removal of ultraviolet coating (insufficient protection)
Re-coating of lens using lacquer or other headlamp lens coating products	› Insufficient protection from ultraviolet radiation › Insufficient protection from external influences, for example, stone chipping

Table 3: Repair Type & Potential Failures

5. Repair & Replace Process



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