TECHNICAL

I-CAR NEW ZEALAND REPORT

ALL-NEW 300 SERIES LANDCRUISER

Part II

Aluminium and Steel – A subtle "Mixed Material" strategy for the upper body….

In Part I, we identified the array of metals that are used across both the upper body and full-frame chassis on the LC300 to help understand the significant weight reduction that Toyota have achieved – especially as, in overall dimensional terms and body-over-frame construction, the 200 series that it replaces, is very similar.

While some of that weight reduction can be attributed to the incorporation of Advanced High Strength Steels (AHSS) utilising tailor-welded blanks (laser welding) in the full frame chassis, as well as strategic structural components in the upper body, most savings have been made by the use of new-generation aluminium.

The other important point to realise when measuring the extent of weight savings is the fact that every electronic feature added (cameras, sensors, wiring and control modules for ADAS) increases the curb weight dramatically. This is certainly true of the new Landcruiser when we look through the specifications list (as shown in Part I).

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THE PROGRESSIVE ADVANCEMENT OF ALUMINIUM FOR AUTOBODY APPLICATIONS:

While there is nothing new about using aluminium for exterior body panels, its use has mainly been confined to low stress bolt-on components such as the bonnet & boot lid / tailgate – more recently, front guards/fenders have also been added to that list of closure panels.

The use of aluminium for structural parts has, by and large been limited to crash management parts such as crash beams / bumper reinforcements and intrusion bars.

In Toyota's case, the best existing example of the expanded use of aluminium is the new RAV4 platform, which now features the latest generation of Novelis heat treatable alloys (Advanz TM 6HS – S600 & 6HS – e600) for the bonnet, lift gate and front guards / fenders.

Toyota announced Novelis as Aluminum Supplier for 2019 RAV4

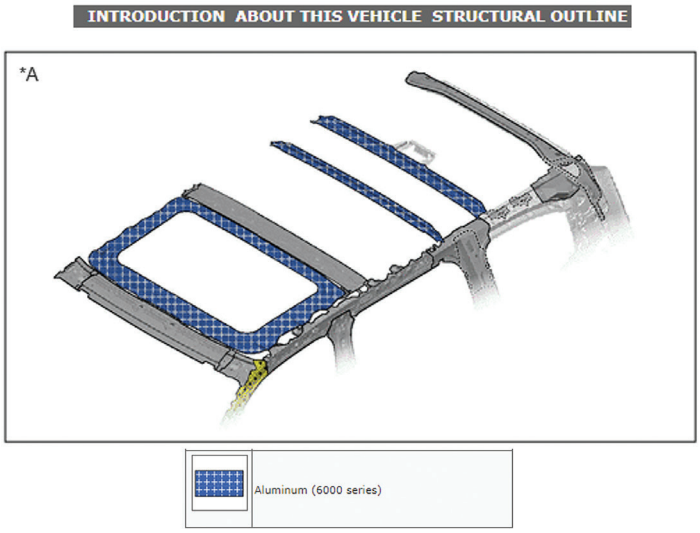
Apr 19,2019

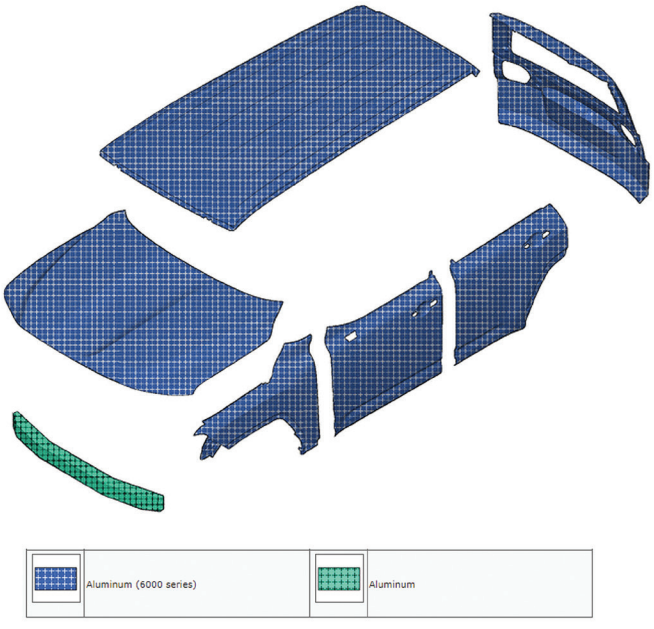
Toyota Motor Corporation selects Novelis Inc the world leader in aluminum rolling and recycling as a supplier for Toyota Motor with premium aluminum automotive body sheet for the all-new 2019 Toyota RAV4. The RAV4 is Toyota's best-selling non-pickup-truck and the number-one-selling vehicle in the country. With a new-and-improved design, the fifth-generation model of the RAV4 is four percent lighter than previous models that include Novelis aluminum in the hood, fenders, and liftgate.

The expanded use of aluminium technologies is significant in the new Landcruiser 300 for two reasons :-

1. The aluminium roofskin (and some associated parts), and its connection method to the steel Body-In-White (BIW) – (lightweighting and lowering the centre of gravity – COG).
2. The door shell is constructed from aluminium (arguably a first for a mass-produced body-over-frame, predominately steel bodied vehicle).

EXCERPTS FROM THE TOYOTA BRM : -





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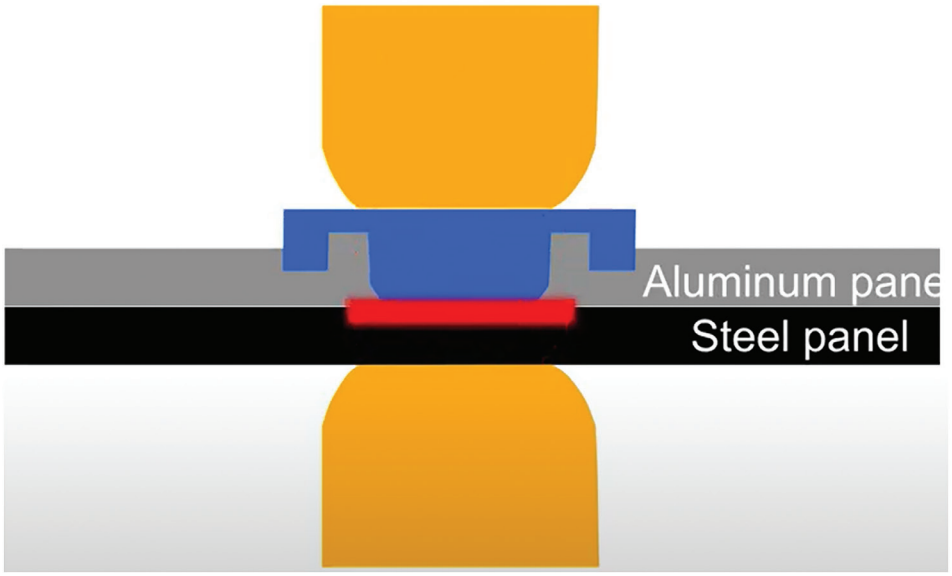
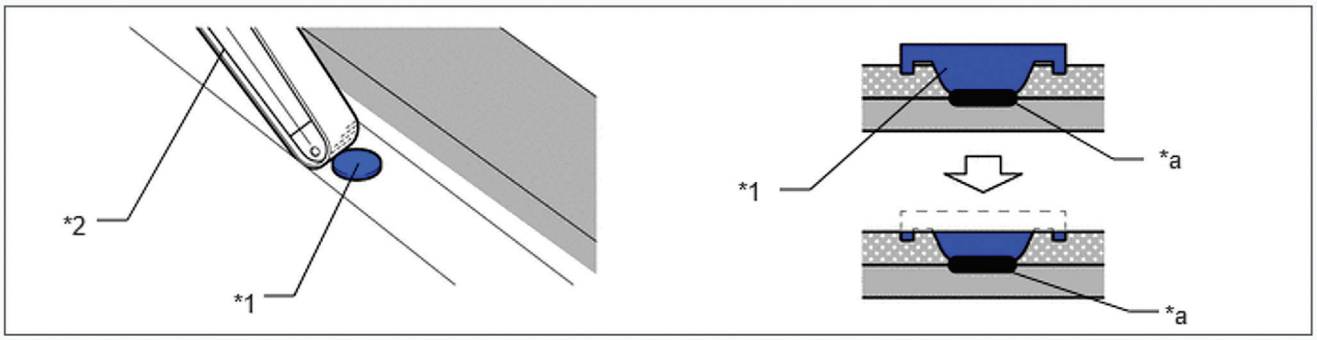
A CLOSER LOOK AT THE ROOF PANEL REPLACEMENT PROCEDURE :

Toyota have developed several special attachment methods for connecting the aluminium roof skin to the steel bodyside / cant rail structure on the 300 series :-

- **Resistance Pierce Welding (RPW) –** this is a process where solid steel rivets are positioned on the roofskin flanges and resistance spot heated to the point where the alloy sheet is softened enough to allow the rivet to pass through, which is then fused to the steel cant rail structure underneath.

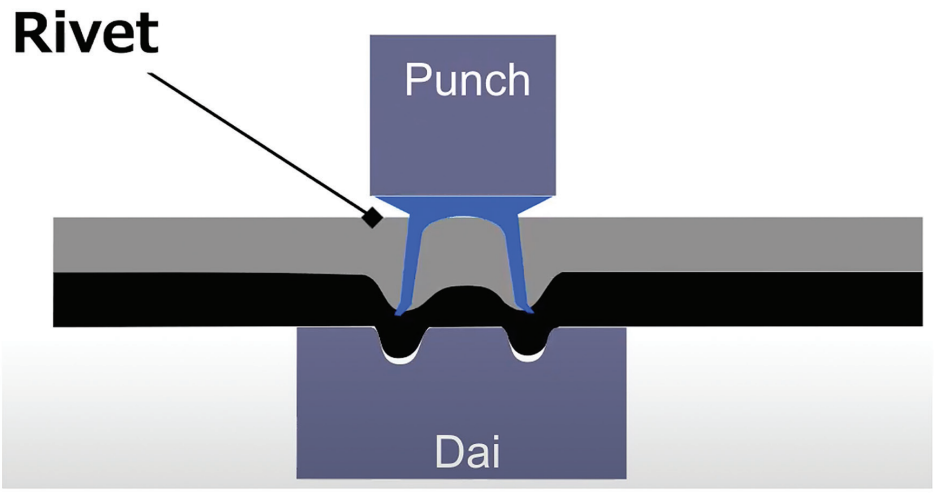


The removal procedure recommends that these connections are ground down with a belt sander – being careful not to damage the base material..

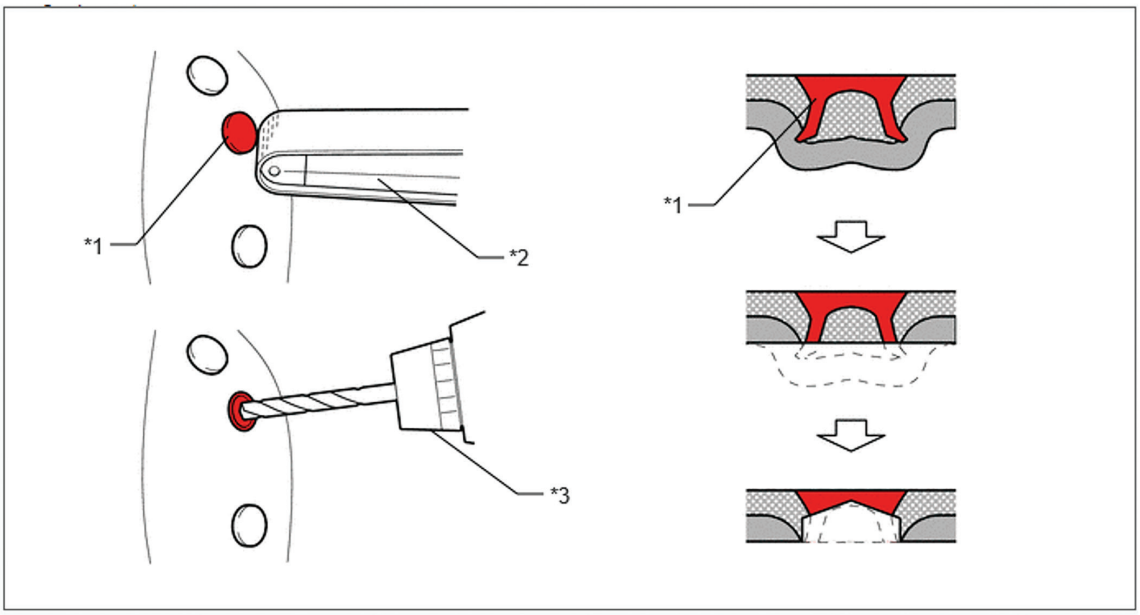


*1	RPW	*2	Belt Sander
*a	Welding Part	-	-

- **Self – Piercing Rivets (SPR) –** This attachment process is arguably fairly well-known in the collision repair industry, and is used by many different vehicle-makers for attaching aluminium parts / structures together –



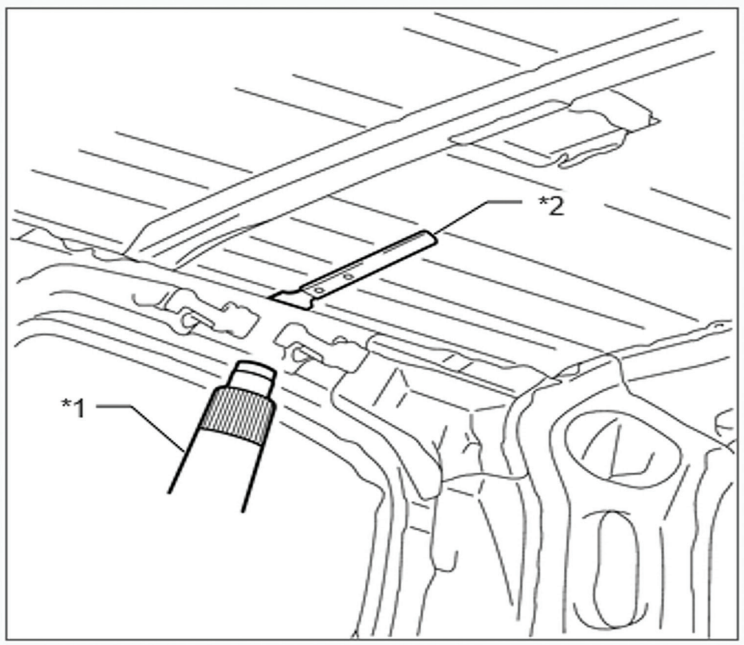
SPR REMOVAL PROCESS :



*1	SPR	*2	Belt Sander
*3	Drill	-	-

In addition to these mechanical attachment methods, Toyota includes the use of adhesives on the flange joints at defined locations – The specification is 3M Automix 08115 Panel Bonding Adhesive. The method also contains info about foamed sealing material (NVH).

REMOVAL INFORMATION FOR ADHESIVE :



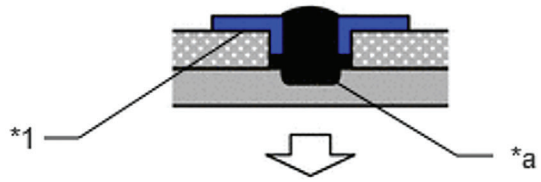
*1	Industrial Heater Gun
*2	Scraper

HINT:
Use an industrial heater gun (160 to 200 °C) to apply heat.

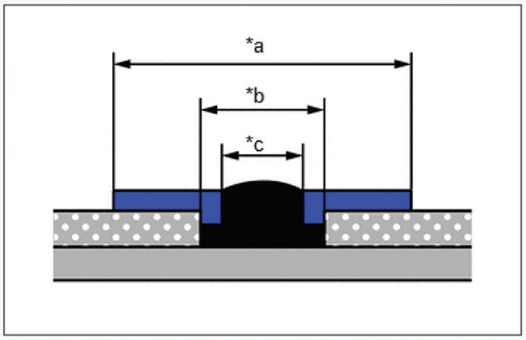
THE INSTALLATION PROCEDURE :

The Resistance Pierce Welding (RPW) process (as used at the factory) cannot be replicated, so Toyota have developed a special attachment method using a steel collar that is inserted into a pre-punched / drilled hole on the panel flange and then MIG welded directly to the base metal of the cant rail.

Toyota call this attachment method **E**lement **A**rc **S**pot **W**elding (**EASW**) – with the specifications shown:

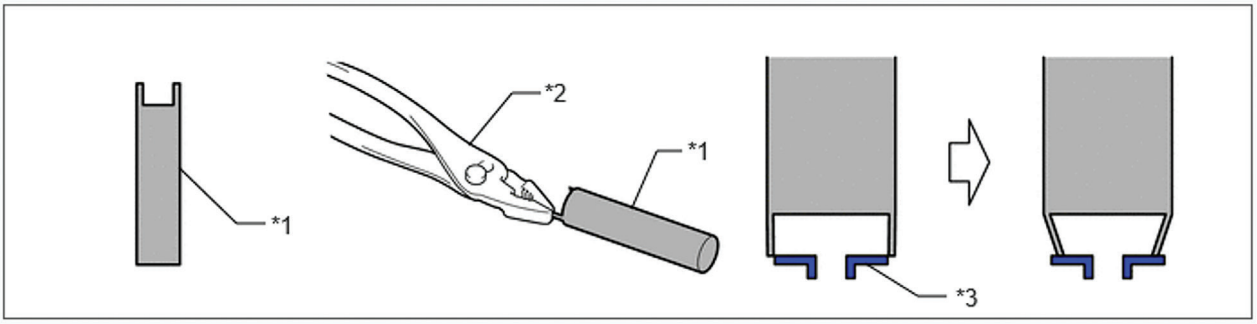


*1	EASW
*a	Welding Part

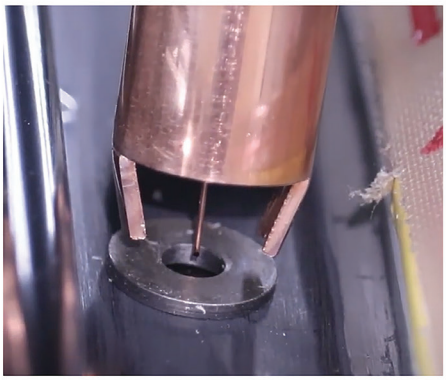


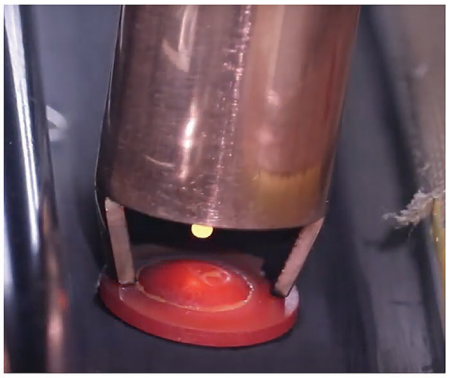
*a	φ16 (0.63 in.) +/-0.1
*b	φ8.5 (0.33 in.) +0 -0.1
*c	φ6 (0.24 in.) +/-0.1

This process requires pressure on the steel ring to maintain contact to the base metal (no gap is allowed) – this means that the diffuser / nozzle on the MIG welding gun requires modifying:-

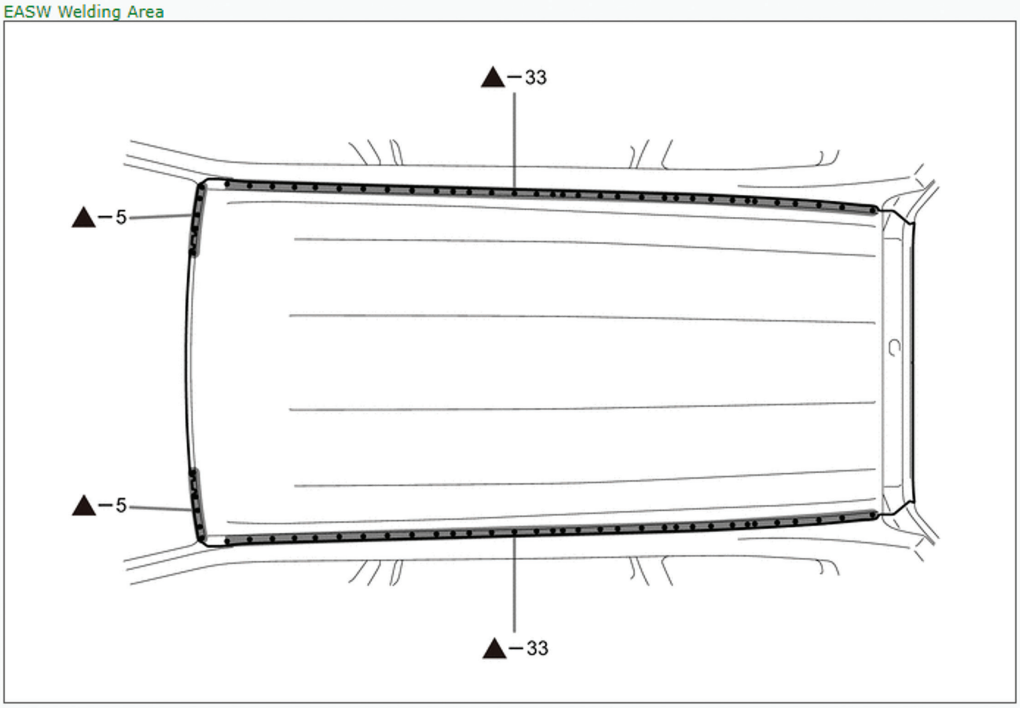


*1	Arc Spot Nozzle	*2	Pliers
*3	Element	-	-





EASW Welding Area

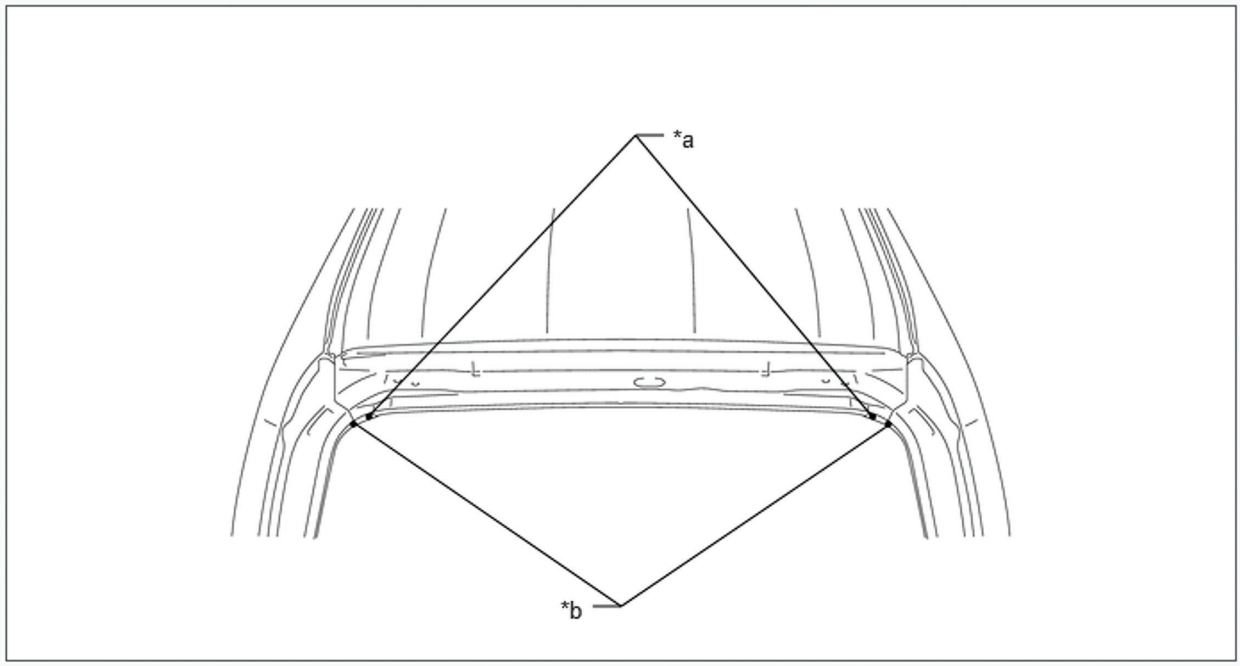


▲	EASW	-	-

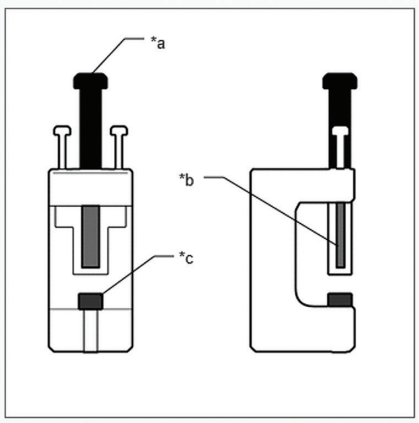
Self-Piercing Rivets (SPR) installation is also different than what is considered to standard methodology across the automotive industry – most OEM's require replacing SPR's in a different location than the originals, because as the name suggests, the rivet setting process creates its own penetrations into the joint – not possible when a hole is created in the base material by the removal process.

Toyota require re-installing new SPR's in the existing location / hole, using an OEM tool or Special Service Tool (SST) called a Clamping Riveter – a new rivet is installed into the existing hole on the car which is also drilled out of the new panel. This is then "tightened" using the manual clamping riveter up to a specified torque that sets the rivet and replicates the original appearance of the joint in the locations where these connections are made at the factory…

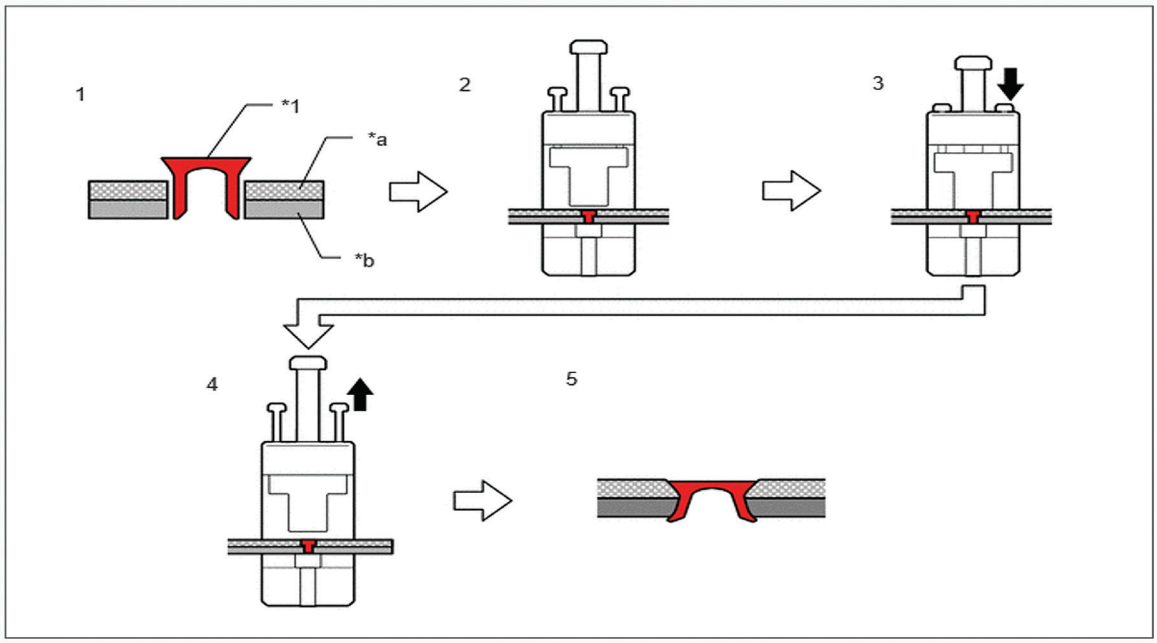
HINT:
SPR Installation Area



*a	90267-05004	*b	90267-05002



*a	Clamping Bolt
*b	Nose Insert
*c	φ5 (0.20 in.) Dice



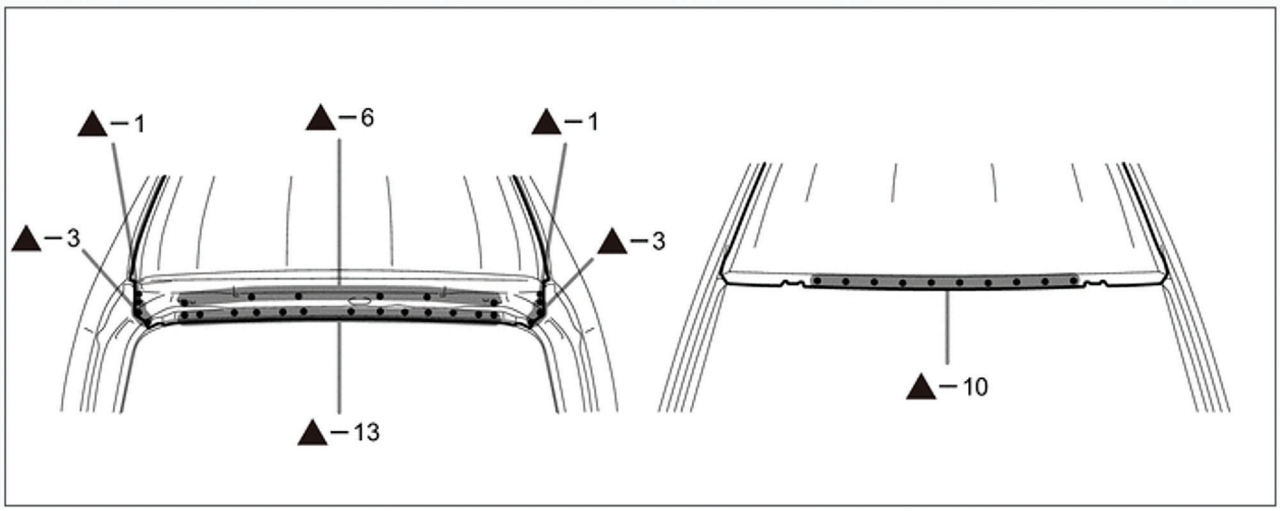
*1	SPR	-	-
*a	Upper Panel	*b	Lower Panel

There are also certain areas that Toyota identify as requiring the installation of blind rivets :-

Open a 6.6 mm (0.26 in.) to 7.0 mm (0.28 in.) diameter hole in the blind rivet installation area on the aluminum roof panel.

HINT:

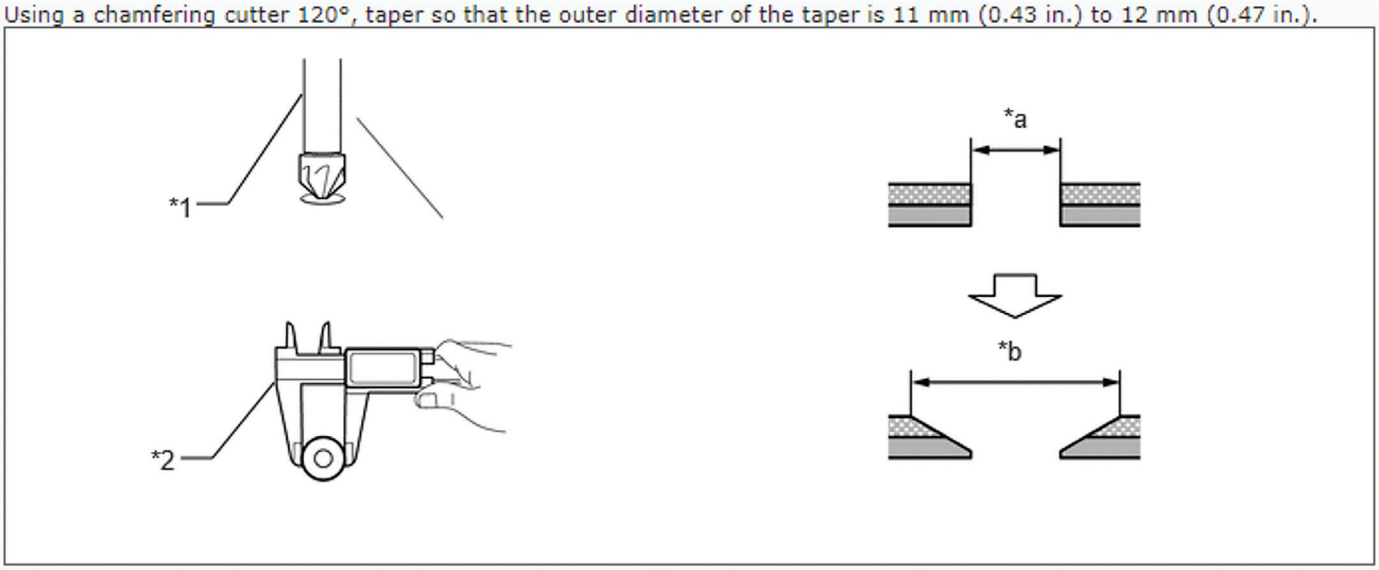
Blind Rivet Installation Area



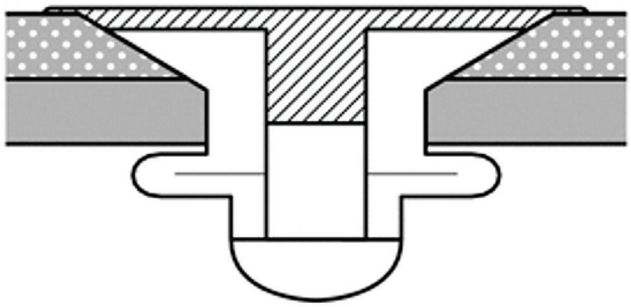
▲ Blind Rivet

As seen with other fastening systems for the 300 roof panel, blind rivet specifications are detailed – by necessity they are required to be flush fitting – therefore a taper is required …

Using a chamfering cutter 120°, taper so that the outer diameter of the taper is 11 mm (0.43 in.) to 12 mm (0.47 in.).



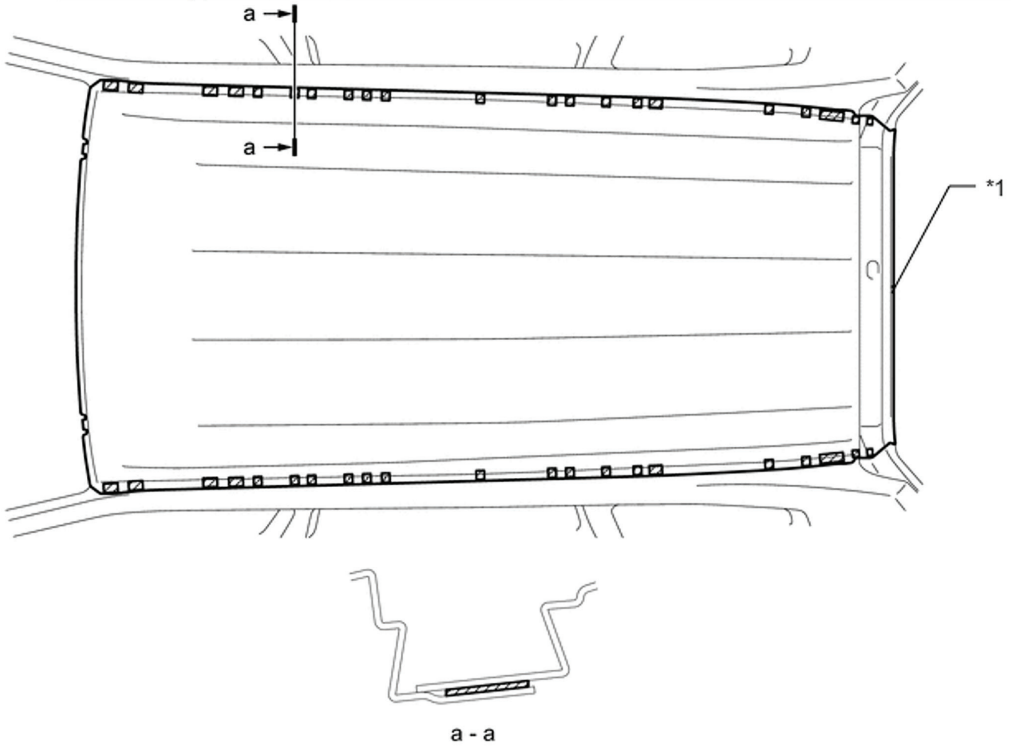
*1	Chamfering Cutter 120°	*2	Vernier Caliper
*a	φ6.6 (0.26 in.) to φ7.0 (0.28 in.)	*b	φ11 (0.43 in.) to 12 (0.47 in.)



Adhesives are required along the mating flanges of the side flange joints and are also used to seal / secure several of the blind rivet installations…

HINT:

Adhesive application areas.

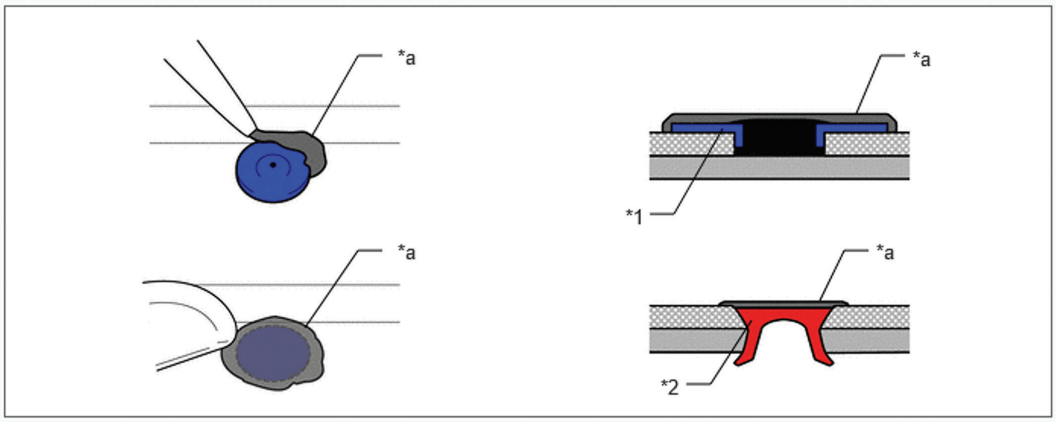


Finally, body sealer is applied on all EASW, SPR's and blind rivet locations to ensure the joints are sealed completely.

iii. Apply body sealer to the SPR and EASW entire circumference, and smooth it using a spatula.

NOTICE:

The entire circumference must be completely sealed.



*1	EASW	*2	SPR
*a	Body Sealer	-	-

For the full roof replacement method, please contact either I-CAR (Technical Information Request), or your local Toyota dealer – Note that Toyota have recently released a technical bulletin about the new 300 Landcruiser whch includes a link to a 21 minute YouTube video that takes the viewer through the entire process …

Technical

TOYOTA

Subject:	LC300 Aluminium Roof Panel Replacement Procedure	**Section:**	08 Body Interior Exterior
Date:	1/09/2021	**Bulletin:**	2144
		Model:	LC300

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Subject: LC300 Aluminium Roof Replacement Procedure

This is the first time a Land Cruiser has been fitted with an aluminium roof panel, due to this aluminium roof panel being fitted, there is a new model specific replacement procedure.

It is essential that the information from the Body Repair Manual is followed correctly to achieve a new car finish. To assist with this, there is also a link to an instructional video provide by Toyota Motor Corporation as well as a QR code.

https://www.youtube.com/watch?v=zxV0EqYjgiA

These articles have been written by Martyn Lane: I-CAR Instructor, Weld Test Administrator and Technical Specialist to the auto body industry